DEPARTMENT OF THE NAVY
FISCAL YEAR (FY) 2007
BUDGET ESTIMATES SUBMISSION

JUSTIFICATION OF ESTIMATES
FEBRUARY 2006

RESEARCH, DEVELOPMENT, TEST & EVALUATION, NAVY
BUDGET ACTIVITIES 1-3

DEPARTMENT OF THE NAVY

FY 2007 RDT&E PROGRAM

SUMMARY
($ IN THOUSANDS)

FEBRUARY 2006

Summary Recap of Budget Activities	FY 2005	FY 2006	FY 2007
Basic Research	478,406	475,085	455,887
Total Research, Development, Test & Eval, Navy	478,406	475,085	455,887

Summary Recap of FYDP Programs			
Research and Development	478,406	475,085	455,887
Total Research, Development, Test & Eval, Navy	478,406	475,085	455,887

DEPARTMENT OF THE NAVY
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 1319N Research, Development, Test & Eval, Navy

Date: FEBRUARY 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
1	0601103N	University Research Initiatives	01	88,897	86,670	73,322	U
2	0601152N	In-House Laboratory Independent Research	01	19,280	17,367	15,916	U
3	0601153N	Defense Research Sciences	01	370,229	371,048	366,649	U
	Basic Research			478,406	475,085	455,887	
	Total Research, Development, Test & Eval, Navy			478,406	475,085	455,887	

DEPARTMENT OF THE NAVY

FY 2007 RDT&E PROGRAM

SUMMARY
($ IN THOUSANDS)

FEBRUARY 2006

Summary Recap of Budget Activities	FY 2005	FY 2006	FY 2007
Applied Research	802,423	798,892	638,657
Total Research, Development, Test & Eval, Navy	802,423	798,892	638,657

Summary Recap of FYDP Programs			
Research and Development	802,423	798,892	638,657
Total Research, Development, Test & Eval, Navy	802,423	798,892	638,657

DEPARTMENT OF THE NAVY
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 1319N Research, Development, Test & Eval, Navy

Date: FEBRUARY 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
4	0602114N	Power Projection Applied Research	02	153,897	135,454	84,914	U
5	0602123N	Force Protection Applied Research	02	134,211	138,094	123,443	U
6	0602131M	Marine Corps Landing Force Technology	02	33,940	38,016	37,741	U
7	0602233N	Human Systems Technology	02	1,446			U
8	0602234N	Materials, Electronics and Computer Technology	02	3,858	1,500		U
9	0602235N	Common Picture Applied Research	02	100,205	106,391	68,352	U
10	0602236N	Warfighter Sustainment Applied Research	02	118,949	110,056	89,964	U
11	0602271N	RF Systems Applied Research	02	60,316	64,642	42,619	U
12	0602435N	Ocean Warfighting Environment Applied Research	02	69,447	62,470	48,718	U
13	0602651M	Joint Non-Lethal Weapons Applied Research	02	1,880	8,910	6,036	U
14	0602747N	Undersea Warfare Applied Research	02	79,380	84,482	83,435	U
15	0602782N	Mine and Expeditionary Warfare Applied Research	02	44,894	48,877	53,435	U
		Applied Research		802,423	798,892	638,657	
		Total Research, Development, Test & Eval, Navy		802,423	798,892	638,657	

DEPARTMENT OF THE NAVY

FY 2007 RDT&E PROGRAM

SUMMARY
($ IN THOUSANDS)

FEBRUARY 2006

Summary Recap of Budget Activities	FY 2005	FY 2006	FY 2007
Advanced Technology Development	1,008,345	1,022,295	504,634
Total Research, Development, Test & Eval, Navy	1,008,345	1,022,295	504,634

Summary Recap of FYDP Programs			
Intelligence and Communications			1,001
Research and Development	1,008,345	1,022,295	503,633
Total Research, Development, Test & Eval, Navy	1,008,345	1,022,295	504,634

DEPARTMENT OF THE NAVY
FY 2007 RDT&E PROGRAM

EXHIBIT R-1

APPROPRIATION: 1319N Research, Development, Test & Eval, Navy

Date: FEBRUARY 2006

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2005	FY 2006	FY 2007	SEC
16	0603114N	Power Projection Advanced Technology	03	129,578	127,049	76,806	U
17	0603123N	Force Protection Advanced Technology	03	171,710	165,611	61,504	U
18	0603235N	Common Picture Advanced Technology	03	83,365	73,056	61,725	U
19	0603236N	Warfighter Sustainment Advanced Technology	03	90,154	106,927	82,035	U
20	0603271N	RF Systems Advanced Technology	03	63,204	100,982	45,317	U
21	0603640M	USMC Advanced Technology Demonstration (ATD)	03	128,818	88,108	59,170	U
22	0603651M	Joint Non-Lethal Weapons Technology Development	03	5,809	2,358	1,405	U
23	0603727N	Navy Technical Information Presentation System	03	168,195	180,106		U
24	0603729N	Warfighter Protection Advanced Technology	03	68,351	59,327	17,982	U
25	0603747N	Undersea Warfare Advanced Technology	03	36,949	35,110	35,055	U
26	0603757N	Joint Warfare Experiments	03	1			U
27	0603758N	Navy Warfighting Experiments and Demonstrations	03	25,847	48,549	41,308	U
28	0603782N	Mine and Expeditionary Warfare Advanced Technology	03	36,364	35,112	21,326	U
29	0303158M	Joint Command and Control Program (JC2)	03			1,001	U
		Advanced Technology Development		1,008,345	1,022,295	504,634	
		Total Research, Development, Test & Eval, Navy		1,008,345	1,022,295	504,634	

Fiscal Year 2007 Budget Estimates
Budget Appendix Extract Language

RESEARCH, DEVELOPMENT, TEST AND EVALUATION, NAVY

For expenses necessary for basic and applied scientific research, development, test and evaluation, including maintenance, rehabilitation, lease, and operation of facilities and equipment, $16,912,223,000, to remain available for obligation until September 30, 2008: *Provided*, That funds appropriated in this paragraph which are available for the V-22 may be used to meet unique operational requirements of the Special Operations Forces: *Provided further*, That funds appropriated in this paragraph shall be available for the Cobra Judy program. (10 U.S.C. 174, 2352-54, 7522; Department of Defense Appropriations Act, 2006).

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EXPECT FEDERAL PROGRAMS TO PERFORM WELL, AND BETTER EVERY YEAR.

PROGRAM ASSESSMENT

PROGRAM

View Similar Programs

Defense Basic Research

This program supports scientific study and experimentation to increase fundamental knowledge in the physical, engineering, environmental and life sciences of potential importance to the defense mission. The program is carried out primarily through grants to universities and non-profit organizations.

RATING

What This Rating Means

PERFORMING

Effective

- **The program has clear purposes.** It helps develop technologies that provide options for new weapons, helps prevent technological suprise by adversaries and develops new scientists who will contribute to the DoD mission in the future.
- **The program is reviewed regularly by technically capable outside expets, who recommend improvements they believe should be implemented.** The experts indicate that the work is of overall high quality.
- **Research earmarks have increased dramatically in the past 15-20 years.** Such projects contribute less than typical projects to meeting the Department's mission, as they don't have to be screened for relevance or quality, and cost more to administer. Earmarks also reduce incentives for other projects to perform to peak potential, as non-earmarked projects encounter less competition for funding.

IMPROVEMENT PLAN

About Improvement Plans

We are taking the following actions to improve the performance of the program:

- Emphasizing the use of independent review panels in assessing the performance of the program.
- Working with the research community and Congress to explain the need to limit claims on research grant funds to proposals that independently can meet the standards of a strict merit-review process.

LEARN MORE

- **Details and Current Status of this program assessment.**
- How all Federal programs are assessed.
- Learn more about Defense Basic Research.

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EXPECT FEDERAL PROGRAMS TO PERFORM WELL, AND BETTER EVERY YEAR.

PROGRAM ASSESSMENT

PROGRAM

View Similar Programs

Defense Applied Research Program

This program supports scientific study of physical, biomedical, behavioral or other phenomena to determine the means by which a particular military need may be met. This work is a little more advanced and applied than the basic research from which it may arise.

RATING

What This Rating Means

PERFORMING

Moderately Effective

- **Program purpose and design are clear.** The purpose is to support quality science with potential application to the defense mission. The Department has established methodical processes for setting program goals and for reviewing progress.
- **Reviews of the program by external review panels are not independent of program officials.** Some reviewers are government employees with financial associations to the program areas under review.
- **A large part of the program is executed either without the benefit of military or scientific expertise in choosing the funded work or without allowing the applications process to be open to all capable researchers.** Earmarking of projects in the program has increased in the recent past and has led to these problems.

IMPROVEMENT PLAN

About Improvement Plans

We are taking the following actions to improve the performance of the program:

- Ensuring that adequate funding exists to carry promising basic research results through the applied research phase.
- Changing the expert evaluation process to use fully independent review panels in assessing the performance of the program.
- Working with the research community and Congress to explain the need to limit claims on research grant funds to proposals that independently can meet the standards of a strict merit-review process.

LEARN MORE

- **Details and Current Status of this program assessment.**
- How all Federal programs are assessed.

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EXPECT FEDERAL PROGRAMS TO PERFORM WELL, AND BETTER EVERY YEAR.

PROGRAM ASSESSMENT

PROGRAM

View Similar Programs

Marine Corps Expeditionary Warfare

Expeditionary warfare is the temporary use of Marine Corps force in foreign countries. The expeditionary warfare program consists of specific investment programs for aviation assets, amphibious ships, weapons systems, equipment, vehicles, ammunition, and research and development.

RATING

What This Rating Means

NOT PERFORMING

Results Not Demonstrated

- **The Department of Defense has not set long-term performance measures to guide program management and budgeting for expeditionary warfare.** It does not have program measures that asses the most important aspects of expeditionary warfare and its strategic goals.
- **The Department of Defense will review the Marine Corps' lift requirements, both sea and air, and other expeditionary warfare capabilities as part of its 2005 Quadrennial Defense Review.**
- **Marine Corps expeditionary warfare fulfills a distinct role in the national defense.** While both the Army and Marine Corps constitute the Nation's land forces, each force provides unique and complementary capabilities for carrying out military missions. Maritime-based Marines provide a swift and effective means of responding to crises.

IMPROVEMENT PLAN

About Improvement Plans

We are taking the following actions to improve the performance of the program:

- Developing a limited number of meaningful, long-term performance measures for the expeditionary warfare program.

LEARN MORE

- **Details and Current Status of this program assessment.**
- How all Federal programs are assessed.
- Learn more about Marine Corps Expeditionary Warfare.

ExpectMore.gov

EXPECT FEDERAL PROGRAMS TO PERFORM WELL, AND BETTER EVERY YEAR.

PROGRAM ASSESSMENT

PROGRAM
View Similar Programs

DoD Unmannned Aircraft Systems (UAS)

The purpose of this program is to develop and produce unmanned aircraft systems that can perform DoD-required missions for which manned aircraft are not as well suited.

RATING
What This Rating Means

PERFORMING

Moderately Effective

- **Unmanned aircraft systems are being delivered at the required rate and are meeting or exceeding their performance targets.**
- **Individual programs have procedures to improve efficiencies within the program, but the effectiveness of these procedures has not been fully demonstrated.**
- **DoD does not have a comprehensive plan to integrate requirements across the military Services (which manage the individual programs) and thus avoid duplication of unmanned aircraft programs.**

IMPROVEMENT PLAN
About Improvement Plans

We are taking the following actions to improve the performance of the program:

- Reviewing the requirements for unmanned aircraft systems in light of the ongoing global war on terror and the 2005 Quadriennial Defense Review of overall strategy.
- Working to improve the integration of unmanned aircraft systems requirements across the Services to prevent multiple systems with similar missions from being developed.

LEARN MORE

- **Details and Current Status of this program assessment.**
- How all Federal programs are assessed.
- Learn more about DoD Unmannned Aircraft Systems (UAS).

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N
PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
UNIVERSITY RESEARCH INITIATIVES	88,897	86,670	73,322	76,160	77,602	79,229	80,892

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program includes support for multidisciplinary basic research in a wide range of scientific and engineering disciplines that are important for maintaining the technological superiority of the U.S. Navy and for university research infrastructure by acquiring research instrumentation needed to maintain and improve the quality of university research important to the Navy. Multidisciplinary research efforts involve teams of researchers investigating high priority topics that intersect more than one traditional technical discipline. For many military problems this multidisciplinary approach serves to stimulate innovations, accelerate research progress and expedite transition of results to Naval applications. The Defense University Research Instrumentation Program (DURIP) supports university research infrastructure essential to high quality Navy relevant research. The instrumentation program complements other Navy research programs by supporting the purchase of high cost research instrumentation that is necessary to carry out cutting-edge research. The program supports Presidential Early Career Awards for Scientists and Engineers (PECASE), single investigator research efforts performed by outstanding academic scientists and engineers early in their research careers. The program also supports research relevant to the long range detection of improvised explosive devices. This program provides the knowledge base, scientific concepts, and technological advances for the maintenance of Naval power and national security.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N
PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	91,310	75,910	72,905
Congressional Action	0	11,900	0
Congressional Undistributed Reductions/Rescissions	-70	-1,140	0
FY 2005 SBIR	-2,343	0	0
Rate Adjustments	0	0	417
FY 2007 President's Budget Submission	88,897	86,670	73,322

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
This University Research Initiative seeks to improve the quality of defense research conducted by universities and supports the education of engineers and scientists in disciplines critical to national defense needs. The initiative is a collection of specialized research programs performed by academic research institutions. Individual project metrics are tailored to the needs of specific applied research and advanced development programs. Example metrics include extending the life of Thermal Barrier Coatings for transition to Total Ownership Cost Future Naval Capability program. It is projected that the life time of Thermal Barrier Coating on Turbine Blades can be doubled. The National Research Council of the National Academies of Science and Engineering's congressionally directed "Assessment of Department of Defense Basic Research" concluded that the DoD is managing its basic research program effectively.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
UNIVERSITY RESEARCH INITIATIVES	74,718	74,770	73,322	76,160	77,602	79,229	80,892

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project includes support for multidisciplinary basic research in a wide range of scientific and engineering disciplines that are important for maintaining the technological superiority of the U.S. Navy and for university research infrastructure, by acquiring research instrumentation needed to maintain and improve the quality of university research important to the Navy. Multidisciplinary research efforts involve teams of researchers investigating high priority topics that intersect more than one traditional technical discipline. For many military problems this multidisciplinary approach serves to stimulate innovations, accelerate research progress and expedite transition of results to Naval applications. The Defense University Research Instrumentation Program (DURIP) project supports university research infrastructure essential to high quality Navy relevant research. The instrumentation project complements other Navy research programs by supporting the purchase of high cost research instrumentation that is necessary to carry out cutting-edge research. The Presidential Early Career Awards for Scientists and Engineers (PECASE) project supports single investigator research efforts performed by outstanding academic scientists and engineers early in their research careers. The Naval Research Enterprise Explosive Detection project supports research relevant to the long range detection of improvised explosive devices. This project provides the knowledge base, scientific concepts, and technological advances for the maintenance of Naval power and national security.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
MULTIDISCIPLINARY UNIVERSITY RESEARCH INITIATIVE (MURI)	51,068	57,016	56,262

Research efforts include high priority topics that intersect more than one traditional discipline. Multidisciplinary University Research Initiative (MURI) topics are selected to address high priority science and technology directions of the Department of the Navy, including the four ONR Grand Challenges (Naval

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

Battlespace Awareness, Electric Power Sources for the Navy and Marine Corps, Naval Materials by Design, and Multifunctional Electronics for Intelligent Naval Sensors).

Fluctuations in the program value between fiscal years reflect the maturation of existing awards. MURIs are a 3-year grant award, with a 2-year executable option. There were a disproportionate number of new MURI awards that started in 2001. Fluctuations in MURI and DURIP funding levels for the period 2005 through 2007 result from an effort to plan an approximately equal number of new MURI awards each year. Goal is to have approximately 11 new awards each year, engaging the academic community robustly in basic research.

FY 2005 Accomplishments:

• A Broad Agency Announcement (BAA) was used to solicit proposals addressing ten ONR high priority topics. Ten research grants were awarded in response to proposals for the ten ONR topics. These awards were in the priority research areas of interferometry, dielectric materials, materials processing, wavefield prediction, nanostructured materials, semiconductors for radio frequency sensors, river and estuarine flows, magnetic sensors, hypersonic materials, and machine language. New MURI awards totaled $5,200 in FY 2005. $45,868 was spent to continue MURI projects begun in prior years.

FY 2006 Plans:

• Conduct competition for $5,200K of new MURI awards to address selected high priority Naval science and technology areas, transformational initiatives, and grand challenges, including strategically important DoD research areas. Ten topics have been identified for publication in a BAA to solicit proposals. These topics address implosion, remote sensing, energetic material, dynamic ocean models, persistent surveillance, magnetostriction, human performance, fluid-structure interaction, multifunctional chip, and novel vaccines. $51,816K will be spent to continue MURI projects begun in prior years.

FY 2007 Plans:

• Conduct competition for $8,300K of new MURI awards to address selected high priority Naval science and technology areas, transformational initiatives, and grand challenges, including strategically important DoD research areas. About sixteen high priority research topics will be identified for publication in a BAA to solicit proposals. $47,962K will be spent to continue MURI projects begun in prior years.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

	FY 2005	FY 2006	FY 2007
DEFENSE UNIVERSITY RESEARCH INSTRUMENTATION PROGRAM	20,920	16,705	16,039

DURIP funds are provided to universities to purchase relatively high cost research instrumentation that is normally not included in single-investigator type research grants. Individual grants range from $50,000 to $1,000,000, with awards averaging about $240,000.

As noted above in the MURI section, DURIP varies during the 2005 to 2007 period in order to plan an approximately equal number of new MURI awards each year while accommodating the end of the disproportionate number of MURI awards that began in FY 2001. The expectation is that DURIP funding would stabilize after 2008 at about $18M.

FY 2005 Accomplishments:

• In response to the FY 2005 DURIP Broad Agency Announcement, 298 proposals requesting more than $83 million were submitted to ONR and 88 were selected for an award.

FY 2006 Plans:

• Conduct competition for approximately 62 research instrumentation awards to universities.

FY 2007 Plans:

• Conduct competition for approximately 60 research instrumentation awards to universities.

	FY 2005	FY 2006	FY 2007
NRE EXPLOSIVE DETECTION	1,870	0	0

The Naval Research Enterprise Explosive Detection project addresses the Improvised Explosive Device (IED) threat and provides an investment in sensor technology, signal processing, data fusion, pattern recognition and autonomous systems technologies to detect the threat.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

FY 2005 Accomplishments:

• Initiated BAA for technical projects to support long range detection of Improvised Explosive Devices (IEDs), focusing on basic research issues associated with long wavelength (infrared and terahertz) detection of explosives. This is a one time effort.

FY 2006 Plans:

• Not applicable.

FY 2007 Plans:

• Not applicable.

	FY 2005	FY 2006	FY 2007
PRESIDENTIAL EARLY CAREER AWARDS	860	1,049	1,021

Extremely prestigious, presidential-rank, single-investigator research awards in areas of importance to the Department of the Navy, to recognize and encourage outstanding academic scientists and engineers early in their research career. PECASE awards are made by research agencies throughout the federal government. Awards provide national recognition and research grants of $100,000 per year for five years.

FY 2005 Accomplishments:

• Two outstanding university researchers were selected to receive the five-year PECASE research award to conduct research of importance to the Navy. Continued PECASE programs begun in earlier years.

FY 2006 Plans:

• Select two outstanding university researchers to receive the five-year PECASE research award to conduct research of importance to the Navy. Continue PECASE programs begun in earlier years.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

FY 2007 Plans:

• Select two outstanding university researchers to receive the five-year PECASE research award to conduct research of importance to the Navy. Continue PECASE programs begun in earlier years.

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
CENTER FOR CATASTROPHE PREPAREDNESS AND RESPONSE, NYU	0	1,000

This effort supports research at the Center for Catastrophe Preparedness and Response, NYU.

	FY 2005	FY 2006
CENTER FOR MICROWAVE FERRITES AND MULTI-FUNCTIONAL INTEGRATED CIRCUITS	963	0

This effort supported the development of advanced ferrite materials suitable for use in DOD high performance high frequency Radar systems and other electromagnetic platforms.

	FY 2005	FY 2006
CENTER FOR SOUTHEASTERN TROPICAL ADVANCED REMOTE SENSING (CSTARS)	2,412	2,500

FY 2005: This effort supported scientific research in land, atmosphere, ice and ocean sciences, as well as more practical applications in the fields of environmental monitoring, natural hazard assessment, civil defense and defense tactical applications at the Center for Southeastern Tropical Advanced Remote Sensing.
FY 2006: This effort supports the Center for Southeastern Tropical Advanced Remote Sensing (CSTARS).

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

	FY 2005	FY 2006
DEFENSE COMMERCIALIZATION RESEARCH INITIATIVE	3,859	2,800

FY 2005: This effort explored innovative new computing architectures for; collaboration, cross-cluster secure on demand computing, next generation security visualization, the next generation of knowledge management technologies, education in mathematics and science, and technology commercialization.
FY 2006: This effort supports the Defense Commercialization Research Initiative.

	FY 2005	FY 2006
MULTIFUNCTIONAL MATERIALS FOR NAVAL STRUCTURES	1,545	1,000

FY 2005: This effort developed techniques to enable the use of nanoparticles (e.g. clay) for introducing multifunctionality into marine composite matrix materials, such as the embedding of nano-engineered sensors or the introduction of self-healing characteristics. Additionally, this effort focused on developing the basic understanding needed to significantly enhance the fire, corrosion and blast/impact resistance of the marine composite matrix materials.
FY 2006: This effort will include: development of effective processing of nanoparticles with greater compatibility with marine composite matrix systems; incorporation of nanoparticles in marine composites and sandwich structures, and evaluation of mechanical/physical property enhancements; and evaluation of multifunctional attributes of affordable, fire-resistant, core materials for sandwich structures.

	FY 2005	FY 2006
NANOPARTICLE MATERIALS RESEARCH	1,065	0

This effort developed an understanding of the chemical recognition factors that drive adsorption of fouling organism cells to underwater surfaces and developed, for testing, practical samples of new designs and/or formulations. A primary focus of this effort was the micromechanical and nanomechanical characterization of these new anti-fouling/fouling-release coating designs/formulations.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

	FY 2005	FY 2006
NANOSCIENCE RESEARCH	1,446	0

This effort supported nanoscience research to overcome limitations that inhibit the fulfillment of nanomaterials' potential for widespread use in naval structures and sensors with potential dual use applications for homeland security through the development of advanced material technologies focused on innovative composite processing techniques based on computational modeling, multi-functional nanoengineered coatings, and fire and corrosion resistant materials as they relate to pre-emptive warning, prevention and containment of identified threats, and remediation.

	FY 2005	FY 2006
NATIONAL SECURITY TRAINING	963	1,800

FY 2005: This effort supported the Serrano Scholars program, at Columbia University and Hostos Community College, for preparing minority and non-traditional students for careers in foreign affairs.
FY 2006: This effort supports national security training.

	FY 2005	FY 2006
NEURAL ENGINEERING RESEARCH	963	0

This effort addressed fundamental issues to create safer, more effective human-machine interfaces by elucidating the neural computational processes that lead to movement and by developing interfaces that take advantage of this knowledge.

	FY 2005	FY 2006
REMOTE SENSING RESEARCH	963	0

This effort developed an understanding of the surface mechanisms of charge transfer in photo induced charge movement sensors, surface nanocrystal structure in thin film gas sensors and surface enhanced raman scattering-based sensors to further the understanding of sensor capabilities in the detection of explosives and their components.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

	FY 2005	FY 2006
RESEARCH INFRASTRUCTURE- UNIVERSITY OF WASHINGTON APL	0	2,800

This effort supports the research infrastructure at the University of Washington Applied Physics Laboratory.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	19,280	17,367	15,916	16,506	16,910	17,950	18,348

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) sustains U.S. Naval Science and Technology (S&T) superiority by providing new technological concepts for the maintenance of naval power and national security and by helping to avoid scientific surprise while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities. Support of basic biomedical research at the Uniformed Services University for the Health Sciences (USUHS) ended in FY05 in this PE and the RDT&E,N budget. The Department of Navy (DON) component responds to S&T directions of the DON Naval Power 21 transformation plan for long term Navy and Marine Corps improvements and is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command. It enables technologies to significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities. The In-house Laboratory Independent Research (ILIR) program also adds increased emphasis to the revitalization of the scientist and engineer workforce component at the Navy's Warfare Centers and Laboratories by attracting superior candidates and retaining our best members through the provision of exciting and meaningful work. It is managed by the Director of Research of the Office of Naval Research (ONR) and executed by the Commanding Officers (COs) and Technical Directors (TDs) of the Naval Warfare Centers, Naval Personnel Research, Studies, and Technology Organization, and the Bureau of Medicine and Surgery laboratories. The FY05 USUHS component is executed by the President of USUHS.

The vision of the DON S&T strategy is "to inspire and guide innovation that will provide technology-based options for future Navy and Marine Corps Capabilities", where "Innovation is a process that couples Discovery and Invention with Exploitation and Delivery". DON Basic Research, which includes scientific study and experimentation, directed toward increasing knowledge and understanding in national-security related aspects of physical, engineering, environmental, and life sciences is the core of Discovery and Invention. Basic research projects are developed, managed, and related to more advanced aspects of research in some hundred-plus technology and capability-related 'thrusts', which are consolidated in twenty-two research areas. These in turn support the major motivational research focus areas of the Navy and Marine Corps-After-Next: maritime

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

and space environments that impact operational capability; information science/knowledge management in network-centric operations; sensors and electronic systems for surveillance and tactical applications; energy/power/propulsion for performance gain and sustainment; advanced air/surface/undersea and multi-environment Naval platforms design/signature reduction; superior human performance/training/care of Sailors and Marines; and combat casualty care/infectious diseases/military operational medicine.

This portion of the DON Basic Research Program provides participating Navy Centers and Laboratories with funding for: basic research to support the execution of their assigned missions; developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to Naval problems; promoting hiring and development of new scientists; and encouragement of collaboration with universities, private industry, and other Navy and Department of Defense laboratories, in particular the corporate Naval Research Laboratory (NRL).

ILIR projects are selected by Center/Lab COs and TDs near the start of each Fiscal Year through internal competition. Projects typically last three years, and are generally designed to assess the feasibility of new lines of research. Successful efforts attract external, competitively awarded funding. Because the Warfare Centers and Labs encompass the full range of naval technology interests, the scope of ILIR topics roughly parallels that of PE 0601153N, Defense Research Science. In FY05, about 67 projects were completed and 63 were initiated.

In FY05 support for the basic medical research at USUHS provided the only programmed research funds received by the University. In addition, it facilitated the recruitment and retention of faculty; supported unique research training for military medical students and resident fellows; and allowed the University’s faculty researchers to collect pilot data in order to secure research funds from extramural sources (estimated $35 million annually). In FY06 USUHS will move to Health Affairs at OSD.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	19,375	15,500	15,951
Congressional Action	0	2,100	0
Congressional Undistributed Reductions/Rescissions	-15	-233	0
Execution Adjustments	5	0	0
FY 2005 SBIR	-89	0	0
Program Adjustments	4	0	0
Rate Adjustments	0	0	-35
FY 2007 President's Budget Submission	19,280	17,367	15,916

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The ILIR initiative seeks to improve the quality of defense research conducted predominantly through the Navy warfare center laboratories. It also supports the development of technical intellect and education of engineers and scientists in disciplines critical to national defense needs through the development of new knowledge in a military laboratory environment. Initial research focus is often conducted in an unfettered nature since it is basic research, but many projects do focus on applying recently developed theoretical knowledge to real world military problems with the intention of developing new capabilities and improving the performance of existing ones. Individual project metrics then become more tailored to the needs of specific

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

applied research and advanced development programs. Example metrics include a recent project that is expected to result in a ten fold improvement in the ability to optimize the search for underwater mines in a defined region using multiple, cooperating autonomous vehicles through the development of new adaptive sampling algorithms. National Research Council of the National Academies of Science and Engineering's congressionally directed "Assessment of Department of Defense Basic Research" concluded that the DoD is managing its basic research program effectively.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	17,448	15,267	15,916	16,506	16,910	17,950	18,348

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project sustains U.S. Naval S&T superiority, provides new technological concepts for the maintenance of naval power and national security, and helps avoid scientific surprise, while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities. It responds to S&T directions of the DON Naval Power 21 transformation plan for long term Navy and Marine Corps improvements. It is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command, and enables technologies to significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities. It is managed by the ONR Director of Research and executed by the COs and TDs of the Naval Warfare Centers, Naval Personnel Research, Studies, and Technology Organization, Bureau of Medicine and Surgery laboratories, and in FY05 USUHS.

This portion of the DON Basic Research Program provides participating Navy Centers and Laboratories with funding for basic research to support the execution of their assigned missions, for developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to naval problems, to promote hiring and development of new scientists, and to encourage collaboration with universities, private industry, and other Navy and Department of Defense laboratories, in particular the corporate NRL. In FY06 the USUHS effort will move to Health Affairs at OSD.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
OCEAN/SPACE SCIENCES	4,020	3,945	4,129

FY 2005 Accomplishments:

• Continued development of capsule vaccines against Campylobacter Jejuni, a class of vaccine that would protect against one of the major causes of bacterial diarrhea world wide.
• Researched automatic classification and tracking with assignment uncertainties to address fundamental issues in signal processing, especially accurate estimation of tracker error covariance matrices.
• Initiated research into Beaked Whale (Ziphius cavirostris, Mesoplodon densirostris, Mesoplodon europaeus) bioacoustic and spatial/temporal habitat characterization in the Tongue of the Ocean, Bahamas.
• Initiated research into in the field of Nonparametric Tolerance Intervals to construct a distribution-free method to generalize the performance of decision trees and neural networks. This work allows for effective adaptive classification in uncertain environments.
• Initiated research into 3D elastic wave propagation in layered prolate spheroids with losses using the vector wave equation in prolate spheroidal coordinates for sonar array applications.

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting the ONR Grand Challenge in Naval Battlespace Awareness, Innovative Naval Prototypes initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Ocean Acoustics and Undersea Weaponry.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting the ONR Grand Challenge in Naval Battlespace Awareness, Innovative Naval Prototypes initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Ocean Acoustics and Undersea Weaponry.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

	FY 2005	FY 2006	FY 2007
ADVANCED MATERIALS	2,965	2,916	3,035

FY 2005 Accomplishments:

• Explored new materials and advanced structure-property-process relationships involving toughening for high-temperature polymer-matrix composites that are suitable for naval aviation applications.
• Studied shear-enhanced configurations and tailorability of chemical thresholds for polymer materials.
• Researched new magnetic materials for weapons, vibration/noise reduction, energy scavenging, sensors, and sonar transducers.
• Explored the scientific merit of using the decomposition by x-rays and electrolysis of Class II fluoride salts like BaF2 and SrF2 to develop a solid state battery and x-ray detector with physical dimensions less than 1 micrometer on silicon (Si) devices.
• Developed a model for the mechanism of self-healing through the characterization of the thermal and rheological behavior of ethylene-methacrylic acid (EMAA) ionomers with known self-healing behavior.
• Developed an understanding of the effects of surface-immobilization on the function of antimicrobial and germinant molecules.
• Conducted a three-pronged approach to identifying new n-doping systems based on current and new theories of charge stability and transport.
• Investigated the fundamental electromechanical behavior of single crystal ferroelectric materials (PiezoCrystals).
• Initiated exploration of high performance nanocomposite barrier coatings for next generation acoustic sensors.
• Initiated studies applying synthetic chemistry techniques to ferromagnetic materials to control their properties and then elucidate the roles they play in microwave absorption.
• Initiated research into applying refined scattering measurement techniques to a range of suitable sample media in order to investigate the sensitivity and range of applicability (e.g., from the single scattering limit to multiple scattering and beyond).

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting ONR Grand Challenges in Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Electromagnetic Gun & and

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting ONR Grand Challenges in Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Electromagnetic Gun & and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering.

	FY 2005	FY 2006	FY 2007
ELECTRONICS SENSOR SCIENCES	2,268	2,230	2,322

FY 2005 Accomplishments:

• Researched a programmable nonlinear dynamical array to provide a low-power and low-cost integrated sensor-processor consisting of a novel architecture that uses dynamical circuits as the fundamental computational building blocks.
• Explored the effects of the chalcogen element selenium on undoped semi-insulating (USI) gallium arsenide (GaAs) towards new Navy sensors.
• Developed the theory and algorithms to support a numerically tractable, mathematically sound approach to determining the proper allocation of distributed sensor assets (both active and passive) in a tactical environment.
• Researched metal/dielectric periodic multilayer structures thought to exhibit a new type of photonic transmission band corresponding to resonant tunneling of evanescent waves.
• Investigated grating diffraction and its polarization by experiment and theory on surface gratings and volume gratings.
• Examined and characterized the detection statistics at an analog receiver’s decision circuit when the dominant noise source is the optical phase noise of the lasers used in a proceeding coherent fiber-optic antenna remoting link.
• Investigated the possibilities of using nanoscale ferromagnet and superconductor joined systems to serve as ultra-sensitive sensors of weak magnetic fields.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting ONR Grand Challenges in Electric Power Sources and Multifunctional Electronics for Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Persistent Surveillance, and the National Naval Responsibility Initiative in Undersea Weaponry.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting ONR Grand Challenges in Electric Power Sources and Multifunctional Electronics for Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Persistent Surveillance, and the National Naval Responsibility Initiative in Undersea Weaponry.

	FY 2005	FY 2006	FY 2007
INFORMATION SCIENCES	1,918	1,887	1,965

FY 2005 Accomplishments:

• Conducted research into advancing and simplifying the state of the art in quantum dense coding using an optical communications system that will convey, on average, two bits of information from the transmitter to the receiver per transmitted single-frequency photon.
• Conducted research into high-data-rate communication in underwater channels using space-time coding and processing.
• Investigated capture and implementation of the international maritime rules, as provided in the Coast Guard Collision Regulations (COLREGS), into a multi-objective decision framework, to prove a level of autonomous tactical decision making capability for both unmanned underwater vehicles and unmanned surface vehicles and tactical decision aids aboard submarines.
• Conducted research on sea state determination for an autonomous surface craft.
• Explored threat management using passive inference of network infrastructure topology.
• Researched directing the chemical reaction between the electrode surface and a specific ligand of the metal complex, to enable the molecular dipoles to be aligned at the interface generating the asymmetric environment

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

important for nonlinear optics.
• Initiated research into Wavelet inspirited data mining.
• Initiated exploration of natural language communications between humans and information systems.

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting ONR Grand Challenges in Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting ONR Grand Challenges in Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry.

	FY 2005	FY 2006	FY 2007
COMBAT CASUALTY CARE, INFECTIOUS DISEASES & MILITARY OPERATIONAL MEDICINE (USUHS)	1,919	0	0

FY 2005 Accomplishments:

Combat Casualty Care (CCC)
• Completed exploration of the role of energy metabolites in the treatment of hemorrhagic shock and oxidative stress; investigation of the function of natural antibodies (chiefly related to B1 cells) in post-ischemic recovery; and establishment of a basic science framework for using benzoquinone ansamycin to treat traumatic brain injury.
• Initiated investigations of molecular- and cellular-level mechanisms affected by penetrating traumatic brain injury, and of the role of channel activation in ischemic preconditioning.

Infectious Diseases (ID)
• Completed testing of novel combinations of antiviral and anti-inflammatory agents to treat influenza in a

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

rat model; and delineation of interactions between Shigella proteins and host cells to identify new targets for effective treatment of dysentery.
• Initiated work on pilot projects regarding characterization and enhancement of natural protective mechanisms for infectious diarrhea, E. coli, gonorrhea, and influenza.
• Initiated two separate studies of leishmaniasis, one epidemiological investigation of possible domestic transmission vectors that involve returning warfighters, the other of molecular-level mechanisms of natural resistance.

Military Operational Medicine (MOM)
• Delineated the role of the proteasome in neuroprotection from hemorrhagic shock in rats.
• Initiated studies exploring possible genetic basis for abnormal responses to exertional stress such as rhabdomyolysis, with an eye to developing better diagnostic tools, and of the differential effects of nicotine and stress, especially those possibly based on gender.

FY 2006 Plans:

This effort will move to Health Affairs at OSD in FY06.

FY 2007 Plans:

This effort will move to Health Affairs at OSD in FY06.

	FY 2005	FY 2006	FY 2007
HUMAN PERFORMANCE SCIENCES	1,918	1,887	1,965

FY 2005 Accomplishments:

• Exploited the biology of IC-21 macrophages to develop novel detectors and decontaminants for anthrax.
• Researched the precision with which people can abstract information from graphics-based radar displays about the range, speed and angle of approach of contacts.
• Researched into human-in-the-loop intelligent software agent learning.
• Derived basic guidance for the use of animated graphic material for delivery in electronic performance support applications.
• Initiated investigation of the distribution of free subspace identification for data exploration and bi-

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

clustering.
• Initiated development of a specific and sensitive biological sensor for microbial agents employing a partial complement fixation reaction.
• Initiated research into short-term statin administration that can reduce the volume or frequency of precordial bubbles detected immediately following decompression from a hyperbaric exposure.
• Initiated research in the potentiation of B-cell immune responses to Enterotoxigenic Escherichia Coli Surface Antigen 3 (CS3) Adhesin by genetic fusion with a binding peptide.

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting the ONR Grand Challenge in Naval Battlespace Awareness, Innovative Naval Prototypes initiative in Sea Basing, and Naval interest in optimizing human performance in military environments.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting the ONR Grand Challenge in Naval Battlespace Awareness, Innovative Naval Prototypes initiative in Sea Basing, and Naval interest in optimizing human performance in military environments.

	FY 2005	FY 2006	FY 2007
NAVAL PLATFORM DESIGN SCIENCES	1,220	1,201	1,250

FY 2005 Accomplishments:

• Conducted experimental studies and modeling of information embedded shipboard power systems.
• Investigated nonlinear control theory for electric machines and components.
• Investigated strontium fluoride-based heteroepitaxial systems of silicon using compliant substrate techniques.
• Conducted spectroscopic and electrochemical investigations of nanophase vanadium oxides.
• Developed new formulations of behavior-based approaches that are appropriate for unmanned air vehicle control and determined appropriate metrics for measuring system performance.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

• Investigated new ceramic dielectric materials that enable the development of high-voltage/high frequency/low loss/ thermally stable multilayer ceramic capacitors (MLCC).
• Conducted an investigation of polarization and mode changes depending on the environmental stress in single mode fibers as they relate to aircraft control.
• Initiated experimental investigation and theoretical modeling of microscale processes associated with phase change heat transfer.
• Initiated development & integration of high-lift actuators and neuro-science based control for Maritime Reconnaissance Autonomous Vehicle (MRAV).
• Initiated, developed and validated analysis procedures to predict powering, cavitation and unsteady shaft forces for specific water jet designs.
• Initiated activities to measure the Hugoniot shock wave equation of state and fracture strength for structural steels.

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting ONR Grand Challenges in Electric Power Sources and Naval Materials by Design, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Sea Basing, and the National Naval Responsibility Initiative in Naval Engineering.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting ONR Grand Challenges in Electric Power Sources and Naval Materials by Design, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Sea Basing, and the National Naval Responsibility Initiative in Naval Engineering.

	FY 2005	FY 2006	FY 2007
ENERGY SCIENCES	1,220	1,201	1,250

FY 2005 Accomplishments:

• Investigated the decomposition pathways of reactive materials which enhance the Navy’s effectiveness in their use of guide formulators in developing new, tailored reactive materials for future use.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

- Conducted impact shock experiments with shear-enhanced configurations for polymer-based materials.
- Explored the nitramine-metal interface through in-situ characterization of the surface in an ultra high vacuum environment (~1 x 10-10 Torr) using X-ray Photoelectron Spectroscopy (XPS) and Infrared Reflection Absorption Spectroscopy (IRRAS).
- Initiated kinetics measurement studies and understanding of the reaction mechanisms of energetic and binder materials during the combustion process using T-Jump Fourier transform infra-red spectroscopy.
- Initiated study of the effects of impurities and defects on the absorption spectra of material that exhibits a range of shock sensitivity.
- Initiated an effort to develop structures that are conceptually the products of fusing rings such as nitrotriazole, 1,2,4,5-tetrazine, 1,2,3,5-tetrazine, and triazine.

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting ONR Grand Challenges in Electric Power Sources and Naval Materials by Design, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting ONR Grand Challenges in Electric Power Sources and Naval Materials by Design, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
NAVY S&T OUTREACH	1,832	2,100

FY 2005 - The Naval Science and Technology for America's Readiness (N-STAR) effort included the development of an outreach activity at Navy R&D Centers collaborating with universities, community colleges, high schools, and middle schools to create a pipeline of students who are interested in pursuing careers in science and engineering fields. The FY05 effort developed the N-STAR outreach activity at the Naval Surface Warfare Center, Dahlgren Division.

FY 2006 - This effort supports Navy S&T Outreach research.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0601153N Defense Research Sciences

NON-NAVY RELATED RDT&E:
PE 0601101A In-House Laboratory Independent Research (Army)
PE 0601102F Defense Research Sciences (Air Force)

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
DEFENSE RESEARCH SCIENCES	370,229	371,048	366,649	377,950	389,595	397,686	406,632

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) sustains U.S. Naval Science and Technology (S&T) superiority, provides new technological concepts for the maintenance of naval power and national security, and helps avoid scientific surprise. Additionally, it exploits scientific breakthroughs and provides options for new Future Naval Capabilities (FNCs) and Innovative Naval Prototypes (INPs). It responds to S&T directions of the DON Naval Power 21 (NP21) Transformational Roadmap, and Chief of Naval Operations (CNO) N70 Mission Capability Package (MCP) requirements for long term Navy and Marine Corps improvements. Defense Research Sciences is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command, and enables technologies to significantly improve the Joint Chiefs of Staff (JCS) Future Joint Warfighting capabilities. It is managed by the Office of Naval Research (ONR) through Program Officers at ONR Headquarters, and the base program of the corporate Naval Research Laboratory (NRL).

The vision of the DON S&T strategy is "to inspire and guide innovation that will provide technology-based options for future Navy and Marine Corps capabilities", where "Innovation is a process that couples Discovery and Invention (D&I) with Exploitation and Delivery". DON basic research is the core of D&I. It includes scientific study and experimentation directed toward increasing knowledge and understanding in national security related aspects of physical, engineering, environmental and life sciences. Basic research efforts are developed, managed, and related to more advanced aspects of research in some hundred-plus technology and capability-related 'thrusts', which are consolidated in fifteen research areas. These in turn support the major motivational research focus areas of the Navy and Marine Corps; maritime and space environments that impact operational capability, information science/knowledge management in network-centric operations, sensors and electronic systems for surveillance and tactical applications, energy/power/propulsion for performance gain and sustainment, advanced air/surface/undersea and multi-environment Naval platforms design/signature reduction, weapons systems for naval forces, and superior human performance/training/care of Sailors and Marines.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES

Key aspects of the program are the four ONR Grand Challenges which 'inspire and guide' the direction of research: Naval Battlespace Awareness, Electric Power Sources for the Navy and Marine Corps, Naval Materials by Design, and Multifunctional Electronics for Intelligent Naval Sensors. Key aspects also include the National Naval Responsibilities (NNRs), fields upon which a wide range of fundamental Naval capabilities depend, and in which ONR is and likely will remain the principal US research sponsor. NNRs are ratified only after close scrutiny, and currently comprise Ocean Acoustics (started FY99), Underwater Weaponry (started FY02), and Naval Engineering (started in FY03). The basic research portfolio can be represented in three segments of emphasis identified as naval unique, participation, and harvest. Naval unique defines a category where the S&T is important to naval operations and largely undertaken only by the DON. It includes the NNR areas. Participation refers to S&T elements vital to naval operations, and naval investment can leverage funding sources other than DON such as airborne radars, communications and networks, materials sciences, and advanced energetic materials. Harvest defines cross cutting areas of science and engineering with potential to generate unanticipated naval capabilities or savings, and which DON should nurture such as nanoscience (potential new material properties) and the behavioral sciences.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	380,441	356,885	366,680
Congressional Action	0	19,600	0
Congressional Undistributed Reductions/Rescissions	-292	-5,437	0
Execution Adjustments	-3,598	0	0
Federal Technology Transfer	-35	0	0
FY 2005 SBIR	-6,287	0	0
Program 38 Support	0	0	-205
Rate Adjustments	0	0	174
FY 2007 President's Budget Submission	370,229	371,048	366,649

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
Defense Basic Research seeks to improve the quality of defense research conducted predominantly through universities and government laboratories such as the Naval Research Laboratory. It also supports the education of engineers and scientists in disciplines critical to national defense needs through the development of new knowledge in an academic environment. Initial research focus is generally conducted in an unfettered environment because of the nature of basic research, but as more is learned and applications emerge, individual research projects take on a more applied focus. Individual project metrics then become

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES

more tailored to the needs of specific applied research and advanced development programs. Example metrics include a biporous wick structure for thermal management of power electric modules capable of removing 900 watts per square centimeter which was recently been developed by an academia/industry team. The National Research Council of the National Academies of Science and Engineering’s congressionally directed ``Assessment of Department of Defense Basic Research'' concluded that the DoD is managing its basic research program effectively.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
DEFENSE RESEARCH SCIENCES	362,122	346,448	366,649	377,950	389,595	397,686	406,632

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project sustains U.S. Naval Science and Technology (S&T) superiority, provides new technological concepts for the maintenance of naval power and national security, and helps avoid scientific surprise. Additionally, it exploits scientific breakthroughs and provides options for new Future Naval Capabilities (FNCs) and Innovative Naval Prototypes (INPs). It responds to S&T directions of the DON Naval Power 21 (NP21) Transformational Roadmap, and Chief of Naval Operations (CNO) N70 Mission Capability Package (MCP) requirements for long term Navy and Marine Corps improvements. Defense Research Sciences is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command, and enables technologies to significantly improve the Joint Chiefs of Staff (JCS) Future Joint Warfighting Capabilities. It is managed by the Office of Naval Research (ONR) through Program Officers at ONR Headquarters, and the base program of the corporate Naval Research Laboratory (NRL).

The vision of the DON S&T strategy is "to inspire and guide innovation that will provide technology-based options for future Navy and Marine Corps capabilities", where "Innovation is a process that couples D&I with Exploitation and Delivery". DON basic research is the core of D&I. It includes scientific study and experimentation directed toward increasing knowledge and understanding in national-security related aspects of physical, engineering, environmental and life sciences. Basic research efforts are developed, managed, and related to more advanced aspects of research in some hundred-plus technology and capability-related 'thrusts', which are consolidated in fifteen research areas. These in turn support the major motivational research focus areas of the Navy and Marine Corps after Next: maritime and space environments that impact operational capability, information science/knowledge management in network-centric operations, sensors and electronic systems for surveillance and tactical applications, energy/power/propulsion for performance gain and sustainment, advanced air/surface/undersea and multi-environment Naval platforms design/signature reduction, weapons systems for naval forces, and superior human performance/training/care of Sailors and Marines.

Key aspects of the program are the four ONR Grand Challenges which 'inspire and guide' the direction of

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

research: Naval Battlespace Awareness, Electric Power Sources for the Navy and Marine Corps, Naval Materials by Design, and Multifunctional Electronics for Intelligent Naval Sensors. Key aspects also include the National Naval Responsibilities (NNRs), fields upon which a wide range of fundamental Naval capabilities depend, and in which ONR is and likely will remain the principal US research sponsor. NNRs are ratified only after close scrutiny, and currently comprise Ocean Acoustics (started FY99), Underwater Weaponry (started FY02), and Naval Engineering (started in FY03). The basic research portfolio can be represented in three segments of emphasis identified as naval unique, participation, and harvest. Naval unique defines a category where the S&T is important to naval operations and largely undertaken only by the DON. It includes the NNR areas. Participation refers to S&T elements vital to naval operations, and naval investment can leverage funding sources other than DON such as airborne radars, communications and networks, materials sciences, and advanced energetic materials. Harvest defines cross cutting areas of science and engineering with potential to generate unanticipated naval capabilities or savings, and which DON should nurture such as nanoscience (potential new material properties) and the behavioral sciences.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
AIR, GROUND AND SEA VEHICLES	22,624	22,025	24,988

Efforts include: Surface/subsurface reduced signatures; free-surface, subsurface, and propulsor hydromechanics; hull life assurance; advanced ship concepts; distributed intelligence for automated survivability; advanced electrical power systems; air vehicles; air platforms propulsion and power; air platforms survivability and signature control; special aviation projects; Unmanned Air Vehicle/Unmanned Combat Air Vehicle (UAV/UCAV); environmental quality; and logistics. Accomplishments and plans described below are examples for each effort category. Starting in FY 05, resources were realigned from this activity to fund Counter IED efforts in support of the Global War on Terrorism.

FY 2005 Accomplishments:

Air Vehicles
• Continued investigations into controlled initiation and recovery from aggressive non-linear aero-maneuvers conducted by unmanned air vehicles.
• Completed exploration of communications and control concepts for autonomous collaboration between unmanned helicopters.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

Ship Concepts and Hydrodynamics
• Continued the computational and experimental study of Coanda (fluid flow along surfaces) Flows.
• Continued development of reliable sea-keeping prediction methods for advanced surface ship hull forms in heavy seas.
• Continued nonlinear seakeeping code for structural loading of multi-hulls.
• Continued modeling of two-way, unsteady, non-spherical bubble/vortical flow interaction and resulting acoustics.
• Continued modeling and optimization techniques for Naval design of multi-hulls, optimal functional arrangements for both ship and submarine design, and optimization for semi-displacement craft.
• Continued hydrodynamic analysis of fast multi-hull ships.
• Continued Reynolds Averaged Navier-Stokes (RANS) predictions of surface ship motion for high speeds.
• Continued validating a breaking wave prediction method against experimental data.
• Continued development of unsteady field pressure measurement technique using Particle Image Velocimetry (PIV).
• Continued vortex/vortex interaction experiments to understand the tip gap cavitation inception physics.
• Continued expanding nationwide distribution of small underwater remotely operated vehicles for hands-on instruction of Naval Engineering principles at high schools.
• Continued implementation of a nationwide program to educate high school guidance counselors on Naval engineering career opportunities.
• Completed detailed measurements of total wave field and resulting ship motions using new instrumentation.
• Completed wind tunnel experiments to characterize unsteady tip-gap flow in turbomachinery.
• Completed development of LES method for unsteady propulsor tip-gap flow predictions.
• Completed Database efforts for multi-hull and monohull small craft with transfer of two dimensional (2D) body plans into 3D computer aided design (CAD) models.
• Completed application of validated optimization procedure for ducted propellers and podded propellers to design analysis tools.
• Completed transition of Unified Test Environment/Technical Identification, Evaluation System (UTE/TIES) design methodology for application on Submarine Synthesis Tool.
• Initiated investigation of the use of Large-Eddy Simulation (LES) for acoustic prediction.
• Initiated comprehensive Laser-Doppler Velocimetry (LDV) development for unsteady propulsor gap flow characterization.
• Initiated development of modeling of highly unsteady separated flow around ducted propulsor using Large-Eddy Simulation (LES).

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Initiated and completed quantification and modeling of bubble sources around surface ships for prediction methods.
• Initiated modeling and experiments for roughness-wall boundary layer noise.
• Initiated holographic PIV system development for unsteady three dimensional (3D) turbo machinery flow.

Ship Signatures, Structures, and Materials
• Continued development of computational mechanics to provide predictive capabilities of acoustics, linear and nonlinear dynamic response and failure mechanisms of structures.
• Continued further examination of computational mechanics in order to address prediction of acoustic signatures in complex structures, modeling of structural failures and optimization, sensitivity analysis, and error control.
• Continued the structural performance of hybrid ship hulls and hybrid joints subject to sea loads and weapons effects for application to high speed, low signature vessels.
• Continued studies of the structural acoustics of anisotropic propulsion ducts.
• Continued modeling of alternating current sources and propagation.
• Continued evaluating the mechanical behavior of elastomeric coatings and their effects on fracture and failure under extreme dynamic loading.
• Completed study of ductile fracture in naval steels from materials issues through ship sections including ongoing modeling efforts.
• Completed an analytical extension of radiation from elastic duct structures using a rational function approximation.
• Completed initial development of an energy finite element capability for modeling hull flow noise.
• Completed evaluating electromagnetic signature basic physics to further understand low observable and infrared (IR) technology performance against evolving threats.
• Initiated PIV/LDV studies of multiphase bubble flows and interaction with elastic plates in a small quiet water tunnel.
• Initiated pod/hull acoustic interaction measurements at small scale using 3D acoustic holography.
• Initiated power flow inversion methods for complex surface ship structures.
• Initiated LDV of scaling effects studies of unsteady elastic duct and propulsor interaction in a wind tunnel.
• Initiated concept for photonic band gap waveguide.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

Ship and Air Platform Machinery and Systems
• Continued efforts to understand and control the generation and propagation of far-field jet noise.
• Continued evaluation of stability and control of electrical power systems.
• Continued development of advanced magnetocaloric materials for magnetic refrigeration.
• Continued seabasing effort for an Advanced Logistics Delivery System including new technologies for gliders and ship launching methods.
• Completed studies of thermoelectric material requirements for shipboard cooling applications.
• Completed efforts to design and test stability and control mechanisms for power distribution in nonlinear circuits.
• Completed scientific approaches to alternate heat transfer and cooling methodologies.
• Completed examination of turbomachinery flow using holographic PIV.
• Completed validating LES predictions of turbomachinery flow against experimental data.
• Completed integrating distributed heterogeneous control simulation capability into the overall control system simulation infrastructure.
• Completed testing and evaluating control system algorithms and strategies in a virtual environment including affordability issues.
• Completed half and full-scale engine testing of most promising on-board noise reduction technologies (e.g. air/water injection).

FY 2006 Plans:

Air Vehicles
• Continue all efforts of FY 2005 less those noted as completed above.
• Initiate university research in rotorcraft technology areas such as multi-tilt rotor aeromechanics (i.e., flying quality maneuverability/expansion/development/structural modes, autonomous rotorcraft operations in shipboard environment, etc.), active rotor control for enhanced ship board operations, autonomous rotorcraft operations in shipboard environment, and innovative rotor design concepts for naval applications.

Ship Concepts and Hydrodynamics
• Continue all efforts of FY 2005 less those noted as completed above.
• Complete the computational and experimental study of Coanda flows.
• Complete comprehensive LDV development for unsteady propulsor gap flow characterization.
• Complete modeling of two-way, unsteady, non-spherical bubble/vertical flow interaction and resulting acoustics.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Complete validating a breaking wave prediction method against experimental data.
• Complete efforts in nonlinear seakeeping code for structural loading of multi-hulls.
• Complete vortex/vortex interaction experiments to understand the tip gap cavitation inception physics.
• Complete development of unsteady field pressure measurement technique using PIV.
• Initiate the investigation of the effect of roughness on turbulent boundary layers.
• Initiate modeling of two-phase flow using LES method.
• Initiate and complete validation of panel-code prediction of nonlinear waves and capsize using model scale data.
• Initiate and complete validation of prediction methods for bubble sources around surface ships.
• Initiate and complete validation of RANS predictions of surface ship motion in pitch and heave.
• Initiate further examination of computational mechanics to address prediction of acoustic signatures in complex structures, modeling of structural failures and optimization, sensitivity analysis and error control.

Ship Signatures, Structures, and Materials
• Continue all efforts of FY 2005 less those noted as completed above.
• Complete efforts in modeling of ductile fracture in Naval steels.
• Initiate application of an energy finite element capability for modeling flow noise to waterjets and pods
• Initiate new concepts to enable Sea Basing

Ship and Air Platform Machinery and Systems
• Continue all efforts of FY 2005 less those noted as completed above.
• Complete efforts in seabasing for an Advanced Logistics Delivery System.
• Initiate development of control capabilities and distributed intelligence strategies for shipboard systems.
• Initiate integration of distributed heterogeneous control simulation capability into the overall control system simulation infrastructure.
• Initiate test and evaluation of control system algorithms and strategies in a virtual environment including affordability issues.

FY 2007 Plans:

Air Vehicles
• Continue all efforts of FY 2006 less those noted as completed above.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Focus university research in rotorcraft technology areas such as tilt rotor aeromechanics, rotor flow field/ship air wake coupling during shipboard operations, flight simulation of advanced ducted fan air vehicles, active rotor control for enhanced ship board operations, autonomous rotorcraft operations in shipboard environment, and innovative rotor design concepts for naval applications.

Ship Concepts and Hydrodynamics
• Continue all efforts of FY 2006 less those noted as completed above.
• Complete modeling and experiments for roughness-wall boundary layer noise.
• Complete nonlinear seakeeping code for structural loading of multi-hulls.
• Complete RANS predictions of surface ship motion for high speeds.
• Complete development of modeling of highly unsteady separated flow around ducted propulsor using LES.
• Complete holographic PIV system development for unsteady 3D turbo machinery flow.
• Initiate and complete validation of six degrees of freedom (6DOF) RANS for surface ship motions (without capsize).
• Initiate and complete validation of prediction of ship wave breaking and bubbly flow at full scale.
• Initiate study to determine most promising foul-release approaches based on silicones to meet Navy durability requirements for further development and testing.
• Initiate half and full-scale engine testing of most promising on-board noise reduction technologies (e.g. air/water injection).

Ship Signatures, Structures, and Materials
• Continue all efforts of FY 2006 less those noted as completed above.

Ship and Air Platform Machinery and Systems
• Continue all efforts of FY 2006 less those noted as completed above.

	FY 2005	FY 2006	FY 2007
ATMOSPHERE AND SPACE SCIENCES	38,859	22,291	18,709

Efforts include: Marine Meteorology and Prediction; High Frequency Active Auroral Research Program (HAARP) and Space Sciences. Accomplishments and plans described below are examples for each effort category. Starting in FY 05, resources were realigned from this activity to fund Counter IED efforts in support of the Global War on Terrorism.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

Decrease in funding from FY 2005 to FY 2006 is due to HAARP program completion.

FY 2005 Accomplishments:

Marine Meteorology and Prediction
• Continued analysis of results from major field projects on air-sea interaction and transition improvements into applied research to improve the treatment of fluxes in coupled atmosphere-ocean prediction systems.
• Continued the development of next-generation ocean-atmosphere coupled models.
• Continued effort to investigate and better understand the bulk exchanges, aerosol-cloud interaction, and physical processes that take place at the atmospheric boundary layer interface. (Includes NRL investment/performance in this effort.)
• Continued theoretical and observational effort to improve understanding of the fundamental dynamics of mountain waves, including generation, propagation, nonlinear interaction, and wave breaking. (Includes NRL investment/performance in this effort.)
• Continued effort to gain a fundamental understanding of the flow-dependent limits of predictability by combining research in data assimilation and atmospheric instability. (Includes NRL investment/performance in this effort.)
• Completed a major field experiment to investigate air-sea interface processes and better understand the exchanges of heat, moisture and momentum between the ocean and atmosphere; results have led to applied research to improve the treatment of these fluxes in coupled atmosphere-ocean prediction systems.
• Completed field experiments in aerosol-cloud-radiation interaction (with emphasis on sea spray and desert dust aerosols) that improved the understanding of the absorption and scattering of visible and infrared radiation in the atmosphere.
• Initiated investigation into the near-earth environmental effects on electromagnetic propagation. (NRL)

High Frequency Active Auroral Research Program (HAARP)
• Completed improvements in the performance of the HAARP Facility with the installation of transmitters.

Space Sciences
• Continued calibration/validation of meteorological satellite wind (WindSat) polarimetric passive microwave data, and developed the version 1 of the WindSat wind vector retrieval algorithm. WindSat wind vectors have been released to the science community for evaluation. (NRL)
• Continued effort to exploit the polarametric aspect of WindSat for non-ocean surface wind vector Meteorological and Oceanographic Command (METOC) retrievals. Effort this year focused on soil moisture and sea

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

ice. (NRL)
• Continued the development of 3D magneto-hydrodynamic code for simulations of solar filament eruptions leading to flare and coronal mass ejection (CME) activity. (NRL)
• Continued studies of the major October-November 2003 solar activity events and the associated effects on the near-Earth space environment. (NRL)
• Continued effort to improve understanding of tropospheric and stratospheric bulk exchanges through observations and modeling. Effort this year focused on finding individual thunderstorm cells spawned by forest fires (pyro-cumulonimbus clouds) which have injected material into the stratosphere. (NRL)
• Completed development of a new model on the evolving shock geometry and seed particle population in solar flare/coronal mass ejection events to explain the variability in high-energy solar particle events at the Earth. (NRL)
• Completed expansion of modeling of the near-Earth space environment with the development a self-consistent coupled model of the solar wind/magnetosphere/ionosphere system. (NRL)
• Completed evaluating/developing techniques for remediation of nuclear-enhanced radiation belts using amplification induced whistler waves or turbulent plasma created by ionizable chemical release. (NRL)
• Initiated assessment of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.

FY 2006 Plans:

Marine Meteorology and Prediction
• Continue all efforts of FY 2005 less those noted as completed above.
• Complete validation of environmental data and models used by S&T community to ensure reliability and realistic depiction of actual ocean and atmospheric conditions.
• Initiate investigation of sub-grid-scale processes that influence marine boundary layer turbulence, aerosol production and removal, and marine stratocumulus cloud and drizzle formation and dissipation with the goal of improving the predictability of these phenomena in high-resolution mesoscale prediction systems.
• Initiate investigation of Western Pacific tropical cyclone dynamics in order to improve the predictability of storm genesis, structure and intensity changes, radii of maximum winds and effects on sea surface waves.
• Initiate investigation of the effects of radioactively important aerosols on cloud dynamics and thermal structure of the lower atmosphere for the purpose of improving the treatment of these processes in numerical weather prediction models.
• Initiate effort to assimilate WindSat wind vector, Ozone Mapping and Profiler Suite (OMPS) ozone profiles, and Global Positioning System (GPS) temperature and water vapor profile retrievals into NOGAPS (Navy

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

Operational Prediction System). (NRL)
• Initiate effort to derive sea foam coverage from WindSat and to use this information in microphysical aerosol models to derive marine optical properties. (NRL)

Space Sciences
• Continue all efforts of FY 2005 less those noted as completed above.
• Initiate assessment of advanced improvements to specification and prediction of the space environment to improve space system performance and their on-call availability. (Includes NRL investment/performance in this effort.)
• Initiate assessment of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.
• Initiate assessment of advanced improvements to specification and prediction of the space environment to improve space system performance and their on-call availability. (Includes NRL investment/performance in this effort.)
• Initiate development and evaluation of techniques for remote sensing of upper atmosphere phenomena including neutral density, winds and bulk exchange cycles. (NRL)

FY 2007 Plans:

Marine Meteorology and Prediction
• Continue all efforts of FY 2006 less those noted as completed above.
• Initiate assessment of the status of aerosol observation, prediction, and understanding for use in slant-range visibility and electro-optical performance prediction models.

Space Sciences
• Continue all efforts of FY 2006 less those noted as completed above.
• Initiate program to develop advanced improvements to specification and prediction of the space environment to improve space system performance and their on-call availability.
• Initiate monitoring of other-agency efforts for Naval Harvest of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.
• Initiate a focused program to develop a predictive, operational capability for the onset and evolution of equatorial spread-F that limits space-based communications and navigation capabilities. (NRL)

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Initiate a program to use large high frequency/very high frequency (HF/VHF) arrays to investigate fine scale ionospheric phenomena with associated improvements in ionospheric modeling and the performance of current and future DoD capabilities impacted by ionospheric disturbances. (NRL)

	FY 2005	FY 2006	FY 2007
COUNTER IMPROVISED EXPLOSIVE DEVICE (IED) SCIENCES	14,214	22,108	20,614

The ONR Basic Research Counter IED program seeks to develop innovative scientific concepts that will form the foundation for future technologies that may be developed and implemented to efficiently and effectively address the IED threat. The effort will emphasize fundamental scientific concepts that can be applied to the detection, neutralization, destruction and mitigation of the effects of these devices and to advance prediction of the occurrence or potential occurrence of IED events. The program also seeks to establish and nurture a multi-disciplinary counter-IED Science and Technology community of Government, academic and industry researchers to accelerate the transition of new science and technology into fielded systems.

Funds were realigned from other activities to fund these efforts described below.

FY 2005 Accomplishments:

• Completed development of new tissue simulants and modeling capabilities that simulate bio-tissue for GelMan surrogate human thorax models used to measure blast wave effects and evaluate personnel protection systems from blast weapons including conventional, enhanced blast devices and IEDs. (NRL)
• Continued computational fluid dynamics (CFD) CT-Analyst technology that provides a sensitive operational-quality capability to backtrack airborne detections of the chemical signatures and taggants of explosives instantly to their source. (NRL)
• Continued reactive flow dynamics study of multiphase reactive flow modeling and simulation that can be applied to investigate mitigation strategies to counter the IED threat. (NRL)
• Continued laboratory-on-a-chip studies of molecular dynamics and recognition including complex, integrated separations performed on a rapid timescale for DoD target analyses such as toxic industrial chemicals and chemical warfare agents which may be used in IEDs. (NRL)
• Continued flame suppression mechanism investigation of additives to fine water mist to provide the scientific basis to guide search for suitable fine water mist based fire suppression strategies for DOD platforms, and to mitigate explosive blast effects. (NRL)
• Continued solid hybrid nanoporous materials investigation to develop robust biosensors, reactive filters,

and high capacity sorbents to detect/defeat improvised weapons. (NRL)
• Continued investigating neutron-sensitive glass materials for remote radiation sensing to develop novel approaches for detection of radiological threats: special nuclear materials, dirty bombs, IEDs. (NRL)
• Initiated effort in the area of Prediction to develop theoretical and technical approaches that permit prediction and analysis of IED emplacement as well as the assembly of IEDs. This included recognition of emplacement patterns, human activity recognition from video and other sensing systems, human intelligence and social network analysis of terrorist networks, modeling and simulation of the full spectrum of IED activities, analysis of communications, and knowledge management systems to combine diverse data sources.
• Initiated effort in the area of Detection to develop concepts that would permit stand-off detection and localization of the explosive, the case materials, the environment in which the device is located, and other components of the IED.
• Initiated effort in the area of Neutralization to develop scientific concepts that may be applied to remotely render an IED ineffective without necessarily having to detect or destroy it.
• Initiated effort in the area of Destruction to develop scientific concepts that may be applied to quickly and remotely destroy IEDs without necessarily having to detect them.
• Initiated effort in the area of Mitigation to develop scientific concepts that may be applied to protect people and/or equipment from the destructive effects of an IED that may be detonated.
• Initiated the study of radar for active detection of suicide bombers. (NRL)
• Initiated exploration into advanced microarchitectures for bioprocessing and sensing to develop and characterize cellular microarrays expressing G-protein coupled receptors (GPCRs) and other proteins as targets for environmental detection. (NRL)
• Initiated the study of molecular motions & physical properties under stress to develop better elastomers for applications of flexible materials (blast resistant coatings, sonar domes, appliqués). (NRL)
• Initiated studies of the fundamental issues in processing of quartz-crystal microbalance arrays directed to making micro-arrays of quartz crystals, each working at different frequencies. (NRL)

FY 2006 Plans:

• Continue all efforts of FY 2005 less those noted as completed above.
• Initiate investigation and development of nonlinear methods to more effectively describe and analyze hyperspectral and multi-sensor data to improve characterization using nonlinear (manifold) methods. (NRL)
• Initiate activities to devise and demonstrate chemical templates for assembling/ positioning nanoclusters and nanowire leads with nanometer precision to better understand the chemical & biochemical assembly of nanocluster-based electronics/sensors. Investigate ultra-fine electroless deposition for forming electrical

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

leads. Explore early applications to single-electron devices and high-sensitivity sensors. (NRL)
• Initiate study of metal nanoparticles for insensitive munitions (IM) with high energy density and low sensitivity to hazardous conditions, operational environment and countermeasures. (NRL)
• Initiate development of rapid identification of biological aerosols, a novel method that allows specific biological aerosols to be identified within a background of others and that can fulfill the criteria of continuous sampling, real time performance, use of a small amount of consumables, and portability. (NRL)
• Initiate a systems biology approach for the interrogation of marine microorganisms to describe and predict the functioning of an entire marine bacterial system in response to certain stimuli which will provide the ability to comprehensively model and manipulate microbiological systems for the development of next generation sensors for biological, chemical and explosive agent detection. (NRL)
• Initiate synthetic nanopores for single molecule identification to demonstrate a novel synthetic-nanopore-based strategy for real-time, label-free, single molecule detection of chemical and biological threats. (NRL)

FY 2007 Plans:

• Continue all efforts of FY 2006 less those noted as completed above.

	FY 2005	FY 2006	FY 2007
HUMAN SYSTEMS	7,062	7,960	8,181

Efforts include: human factors and organizational design; manpower, personnel, and training; integrated avionics, displays, and advanced cockpit; and pattern recognition.

FY 2005 Accomplishments:

• Continued study of social networks for counterterrorism.
• Continued research on how people represent and understand uncertainty.
• Continued studies of the interaction of auditory and visual displays.
• Continued expansion of cognitive architectural modeling capability to increase coverage, including spatial reasoning, multi-tasking, impact of physiological and stress variables, etc.
• Continued research on human cognition and performance to create more realistic simulations for training.
• Continued program to combine cognitive architectures with computational neuroscience to better predict human performance.
• Continued development of novel multidisciplinary approaches to human-activity inference from video imagery

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

to enable force protection and counterterrorism.
• Continued program on implantable electronics for performance enhancement.
• Continued studies of hierarchical, cellular, and hybrid organization structures for command and control.
• Continued schema theory applications to multi-echelon command decision making.
• Continued investment in natural language interaction capability for artificially intelligent training systems.
• Completed study of retinal information processing and modeling environments.
• Initiated study of neuro-control of Unmanned Underwater Vehicles (UUVs) and active vision and cognitive navigation skills in mobile robots.
• Initiated investigations to support new missions for Expeditionary Strike Groups in three areas: 1) analysis and diagnosis of Command and Control Organizational structures; 2) effects-based operations and development of reach-back capability for course of actions analysis; and 3) decision support systems for management of Battle Rhythm.
• Initiated social-science based computational toolsets for terror network analysis at PACOM'S Joint Intelligence Center and on the USS TARAWA (LHA-1) to support Expeditionary Strike Group One in the Global War on Terrorism.

FY 2006 Plans:

• Continue all efforts of FY 2005 except those noted as completed above.
• Complete research on how people represent and understand uncertainty.
• Complete studies of attention management in multi-tasking.

FY 2007 Plans:

• Continue all efforts of FY 2006 except those noted as completed above.
• Complete studies of the interaction of auditory and visual displays.
• Complete development of novel multidisciplinary approaches to human-activity inference from video imagery to enable force protection and counterterrorism.
• Complete expansions to cognitive models to include spatial reasoning.
• Initiate computational and agent-base modeling and experimentation to explore options for Effects-Based Operations.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Initiate models of operational decision making for component commanders of an Expeditionary Strike Group with special emphasis on elaboration and planning knowledge.

	FY 2005	FY 2006	FY 2007
INFORMATION SCIENCES	22,318	22,279	22,670

Efforts include: Computational theory and tools for design, communication, and control of intelligent autonomous systems; decision theory, algorithms, and tools; heterogeneous information integration, management, and presentation; information assurance, secure and reliable information infrastructure for Command and Control; mathematical optimization for optimal resource allocation and usage; modeling and computation of complex physical phenomena; modeling and computation for electromagnetic and acoustic wave propagation and scattering; seamless, robust connectivity and networking; and expeditionary operations Command, Control, Communications, Computers Intelligence Surveillance and Reconnaissance (C4ISR). Starting in FY 05, resources were realigned from this activity to fund Counter IED efforts in support of the Global War on Terrorism.

FY 2005 Accomplishments:

• Continued development of mathematical optimization framework and heuristic algorithms that serve as theoretical and computational basis for network design, optimal sensor allocation, and logistics.
• Continued development of improved tactical and battlespace decision aids through creation of synthetic natural environments.
• Continued to refine techniques for extracting maximum knowledge from multi-modal imagery, text, and electromagnetic signal data.
• Continued to investigate methods to deal with light dispersion on image formation underwater to enable precise navigation, station keeping, and mapping capabilities for unmanned underwater vehicles.
• Continued efforts for enabling teams of autonomous systems to work together and work on representations for evolution of cooperative behaviors, including efforts in multi-modal interactions with autonomous systems.
• Continued developing framework for dealing with effect of variable latencies in communication within teams of humans and autonomous systems.
• Continued efforts on development of mathematical foundations for image enhancement, feature extraction, feature-based/texture-based compression, denoising, and segmentation; data representation and metrics, content-based indexing and retrieval; reconstruction, interpolation, and registration; and scene analysis and image understanding.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

- Continued efforts on quantum computing and cryptography.
- Continued efforts on general automated theorem prover technologies and biometric technologies for authentication.
- Continued efforts in multi-modal dialog.
- Continued efforts in physics-based modeling of natural phenomena.
- Continued efforts in mathematical techniques for inverse problems, including reliable approximate solutions in 3D; adequate representation of the physics of the media and the scatterer; and improved resolution of structural and material properties.
- Continued efforts in extended augmented/virtual reality with haptics, sound, and olfactory components.
- Continued development of technology for maximizing information delivery in tactical networks via encoding information under speech. (NRL)
- Continued development of technology for improving behavior of coordinated teams of autonomous systems. (NRL)
- Continued the development of technology to improve tactical wireless ad hoc networks via development of cross-layer design approaches. (NRL)
- Completed efforts on modeling chaotic phenomena in network operations.
- Completed efforts for integrating domain knowledge into learning methods.
- Completed efforts for semantic-based information gathering.
- Completed refinement of theory and algorithms for autonomous systems to recognize a particular scene from different perspectives.
- Completed refinement of turbo-codes and iterative processing techniques to enable high data rates for wireless communication applications.
- Completed development of adaptive routing protocols to select the links for routing information packets that maximize communication network throughput with minimum energy consumption.
- Completed investigation of Extremely Low Frequency modulation and efficiency improvements and magnetospheric propagation.
- Completed development of computational framework for integrating information of disparate sources - Program Decision Memorandum for University Research - Surveillance & Knowledge Systems.
- Completed development of a systematic approach that will serve as a theoretical and computation basis for automated image understanding and automatic object recognition.
- Completed refinement of techniques for ensuring privacy of information transferred across public networks.
- Completed collaborative mission planning tools to facilitate knowledge sharing and management, regulation of information flow, and work-process monitoring.
- Completed development of technology for the automated construction of high assurance software. (NRL)

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete efforts in extended augmented/virtual reality with haptics, sound, and olfactory components.
- Complete development of technology for increasing efficiency of tactical wireless networks based on fundamental invariants for random-access protocols. (NRL)
- Initiate development of technology to re-engineer legacy code. (NRL)
- Initiate development of technology to improve analysis of distributed systems. (NRL)

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete the development of technology to improve tactical wireless ad hoc networks via development of cross-layer design approaches. (NRL)
- Initiate development of technology for improved network management of wireless networks. (NRL)

	FY 2005	FY 2006	FY 2007
MATERIALS/PROCESSES	66,104	64,175	75,871

Efforts include: Structural materials; functional materials; maintenance reduction; Energy Generation, Conversion, and Storage; and Environmental Sciences. Accomplishments and plans described below are examples for each effort category. Starting in FY 05, resources were realigned from this activity to fund Counter IED efforts in support of the Global War on Terrorism.

FY 2005 Accomplishments:

Structural Materials
- Continued development of physics-based models of thermal and materials flow during friction stir welding of steels, including the development of residual stresses that will lead to distortion.
- Continued development of first-principles based methodologies for predicting the thermodynamics and kinetics controlling microstructural evolution for the design of advanced weldable, naval steels.
- Continued design, synthesis, and optimization welding consumables and process methodologies for joining superaustenitic stainless steels.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

- Continued development of understanding and constitutive models of dynamic behavior of naval steels.
- Continued development of physics-based constitutive models of fatigue evolution in naval alloys.
- Continued development of theoretical basis for composite materials behavior based on x-ray computed micro-tomography.
- Continued development of pultruded sandwich structures for improved mechanical characteristics and lower cost for Naval applications.
- Continued investigation of continuous growth of single and multi-wall nanotubes for next generation polymer matrix composite materials.
- Continued development of hybrid composites incorporating glass fibers and high strength steel fibers for joining application.
- Continued exploration of superplasticity in advanced high strain nanometer scale ceramic composites to provide the basis for the development of such materials in Naval applications.
- Continued to advance the understanding of deformation mechanisms in nanometer scale aluminum and steels to provide new high strength-high toughness alloys for Naval platforms.
- Continued development of models and simulations to understand and predict high deformation rate blast behavior for engineered topological structures.
- Continued development of materials and fabrication science for fugitive phase processes for engineered topological structures for ship blast protection.
- Continued development of understanding linking complex reaction paths and atomic diffusion in the formation of environmental and diffusion barrier coatings for high temperature thermal and environmental barrier coatings.
- Continued development of understanding and enhancing the dynamic response (constitutive behavior, failure) for marine composites and sandwich structures.
- Continued development of nanocomposites for enhancing mechanical properties of marine composites.
- Continued investigation of the role of hydrogen and nitrogen on mechanical properties of titanium alloys. (NRL)
- Continued studies on microstructure, mechanical, fatigue crack growth, and corrosion properties of friction stir welded Aluminum 5456. (NRL)
- Continued research on first-principles and experimental data to develop iron-nickel (Fe-Ni) atomistic potentials which will be used in the study of austenitic steels, currently we can show that Ni segregates on high Sigma grain boundaries. (NRL)
- Completed the development of a unified driving force for fatigue crack growth model and verified for alloy steel via laboratory studies. (NRL)
- Initiated evaluation of new high temperature resin for potential Unmanned Combat Air System (UCAS) high

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

temperature composite applications.
• Initiated research tools design efforts in dynamic three dimensional control of structures.
• Initiated investigation of joining dissimilar ceramics and sintering of light metal composites. (NRL)

Functional Materials
• Continued extension of first principle calculations of sonar materials tensor piezoelectric and dielectric properties to complex solid solutions to provide the basic understanding and predictive capability for ultra high strain materials.
• Continued development of a theoretical model that describes coherent multiexciton generation by one photon in PbSe and PbS nanocrystals for new solar cells. (NRL)
• Continued studies on the electron doped cuprate superconductors (Nd2-xCexCuO4 and Pr2-xCexCuO4) by temperature dependent polarized electronic Raman spectroscopy across a wide region of the doping (Cerium) phase diagram. (NRL)
• Completed the synthesis of cadmium selenide (CdSe) and cadmium telluride (CdTe) nanorods as potential “nano-diode” devices. (NRL)
• Completed the development of polynorborene which surpasses the blast resistance of polyurea. (NRL)
• Completed the Autonomic Fire Suppression Engineering Development Model (AFSS-EDM). (NRL)
• Completed the development of prototype biofilm power generator with demonstrated current density of greater than 10 microamps per square centimeter. (NRL)
• Completed development of new thermal dip pen nanolithography method and instrumentation. (NRL)
• Completed development of a predictive model of infrared, Raman and optical signatures of a large ensemble of metastable B10C2 clusters as a function of gas-phase plasma temperature. (NRL)
• Initiated research tools design efforts in electromagnetic and acoustic bandgap materials and other functional materials.
• Initiated a project for the determination of a critical structural phase transition in a new class of superconducting materials. (NRL)
• Initiated a theoretical study on a variety of novel superconductors where superconductivity coexists with magnetism or spin fluctuations. (NRL)
• Initiated construction of a unique facility for exploring static electrical contact phenomena consisting of a servohydraulic load frame with an insulated load train. This equipment will enable studies on transmission of electrical current across dissimilar metal interfaces at extreme pressures and current densities beyond those investigated before. (NRL)

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Initiated studies on dielectric breakdown strength of ferroelectric glass-ceramics to show that it is an order of magnitude higher than conventional ceramic dielectrics while maintaining high dielectric constant. (NRL)

Maintenance Reduction
• Continued exploration of advanced coatings with multifunctional corrosion/fouling properties.
• Continued exploration of theoretical concepts for corrosion control.
• Continued to identify stress corrosion control methods for friction stir welded high-strength aluminum alloys using advanced thermal treatments, chemical modifications, and surface mechanical processes to tailor compressive stresses.
• Continued to develop the science of sliding contact and lubrication using physical and chemical first principles.
• Continued to explore transgranular crack tip damage mechanism in ultra high strength steels.
• Continued to investigate the use of photorefractive crystals for the demodulation of a distributed fiber optic Bragg gratings structural health monitoring system.
• Continued exploration of multienergy processes for zero maintenance coatings.
• Completed hydrogen embrittlement resistant high strength alloys based on nickel-cobalt-chrome-molybdenum material systems.
• Completed development of ultrasonic Lambwave Natural Frequency Focusing technology for crack and corrosion detection in ship tubes and pipes without the need of insulation removal.
• Continued investigation of continuous growth of single and multiwall nanotubes for next generation polymer matrix composite materials.
• Initiated first lubrication-by-design experiments.
• Initiated high temperature, low frictional sliding coefficient materials for elevated operating temperature gas turbine engine bearings.
• Initiated development of laser induced fluorescence for heat damage detection.
• Initiated development of a Giant Magnetoresistance (GMR) array Nondestructive Evaluation (NDE) system for detection of hidden cracks in Navy aircraft.
• Initiated development of an ultrasonic imaging camera for composite patch inspections.

Energy Generation, Conversion, and Storage
• Continued analyzing synchronization of 19 diode lasers to produce intense beams.
• Continued efforts in nanostructures, novel electrolytes, and electrode materials to enable new power sources, improve capacity of rechargeable lithium batteries, and fuel cells.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

- Continued work on developing the scientific basis of nanostructure enhancement of direct energy conversion materials performance for power generation.
- Continued exploration and development of materials for high energy density passive power electronics.
- Continued design of a thermoacoustic piezoelectric generator working via a temperature gradient.
- Continued expanding the fundamental understanding of direct electrochemical oxidation in solid oxide fuel cells and the use of logistic fuels.
- Continued expanding research into new materials and processes for converting thermal to electric energy such as identifying new high figure of merit thermoelectric materials.
- Continued identification of new approaches to efficiently transfer thermal, electrical and optical energy from primary sources.
- Initiated research tools design efforts in Chemical Dynamics and High Temperature Probes.

Environmental Sciences
- Continued examination of scientific methods for pollution prevention, waste reduction, and hazardous material reduction for Naval Operations.
- Continued assessment of the fate and effects of chemical and biological contaminants in marine/estuarine environments.
- Continued broad based program in anti-fouling and fouling release coatings including investigation of effect of fluorinated block co-polymers and novel testing methodologies for coating efficacy.
- Continued effort on pierside robotic hull fouling control/surveillance technologies.
- Continued emphasis on ultrafiltration membranes for bioreactors.
- Continued effort to determine most promising foul-release approaches based on silicones to meet Navy durability requirements.
- Completed conducting membrane research to correlate filtration efficiency with nano-fibrous membrane porosity, thickness, fiber diameter and chemical composition.
- Completed efforts to improve membrane materials for high-flux and low-fouling efficiency with proper composite design, chemical modifications and materials selection.
- Completed efforts to measure the mechanisms for fouling release and to compare the skin friction properties of conventional and fouling release ship hull coatings.
- Completed exploring low-energy laser induced incandescence schemes to avoid soot vaporization and extend light scattering measurements to soot burn-out regime.
- Completed developing bryozoans as new model organism used in assessment of coatings.
- Completed using hydrodynamic drag measurements to quantify force vs. speed on pseudo barnacles attachment to various surfaces.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Initiated research tools design efforts in sampling and analytical methodologies.

FY 2006 Plans:

Structural Materials
• Continue all efforts of FY 2005 less those noted as completed above.
• Complete design, synthesis and development of welding consumables and process methodologies for joining superaustenitic stainless steels.
• Complete development of pultruded sandwich structures for improved mechanical characteristics and lower cost for Naval applications.
• Initiate exploration into the processing and microstructures of novel titanium alloys that may be enabled by new co-reduction of mixed metallic oxide processes.
• Initiate exploration of microstructural evolution during solid-state joining and localized processing of weldments in titanium alloys for improved toughness and fatigue resistance.
• Initiate development of progressive damage models for blast effects on composite marine structures.
• Initiate research into dynamic slamming load effects on marine composites.

Functional Materials
• Continue all efforts of FY 2005 less those noted as completed above.
• Complete projects in 1) Nanofilaments: Interfacial Interactions, Manipulation and Assembly and 2) Half-Metallic Electronic Materials. (NRL)
• Complete protection of carbon nanotubes against oxidation at elevated temperatures and transition into other spin-off programs. (NRL)
• Initiate exploration and prediction of new sonar materials based on first principle methods.
• Initiate study of new transduction mechanisms.
• Initiate examination of the effects of acoustic perturbations and interactions in reacting flows and determine how they can be used. (NRL)
• Initiate investigation of radically new hierarchical polymer lenses that mimic the focusing of an eye. (NRL)
• Initiate single molecule binding detection using optical trap. (NRL)
• Initiate effort to fabricate extended 2-D left handed materials (LHM) structures. (NRL)

Maintenance Reduction
• Continue all efforts of FY 2005 less those noted as completed above.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

- Initiate development of corrosion models.
- Initiate mechanistic studies of materials deterioration under chemical environment for ship materials and their interfaces.
- Initiate testing of a statistically relevant number of combinatorial specimens to rank defects, microstructure and their interactions for fatigue crack initiation and growth. (NRL)

Energy Generation, Conversion, and Storage
- Continue all efforts of FY 2005 less those noted as completed above.

Environmental Sciences
- Continue all efforts of FY 2005 less those noted as completed above.

FY 2007 Plans:

Structural Materials
- Continue all efforts of FY 2006 less those noted as completed above.
- Complete the development of understanding of deformation mechanisms in nanometer scale aluminum and steels for new high strength-high toughness alloys for naval platforms.
- Complete efforts to understand links between complex reaction paths and atomic diffusion in the formation of environmental and diffusion barrier coatings for high temperature thermal and environmental barrier coatings.
- Complete analysis of dynamic response for marine composites and sandwich structures.
- Initiate investigation of a rapid annealing of surface layers and their effects. (NRL)
- Initiate quantification of the Corrosion effects on fatigue to be incorporated into the Unified Damage Model and validate in a few environmental case on P-3 aircraft real loads data.

Functional Materials
- Continue all efforts of FY 2006 less those noted as completed above.
- Complete development of first principle methods to calculate second and third rank tensor properties of sonar materials such as lead zirconate titanate and lead magnesium niobate.
- Complete the piezo electric fracture analysis with experimental and model for verification.
- Initiate synthesis and property measurement of new sonar materials predicted by first principle methods.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

Maintenance Reduction
• Continue all efforts of FY 2006 less those noted as completed above.
• Complete exploration of transgranular crack tip damage mechanism in ultra high strength steels.

Energy Generation, Conversion, and Storage
• Continue all efforts of FY 2006 less those noted as completed above.

Environmental Sciences
• Continue all efforts of FY 2006 less those noted as completed above.
• Complete efforts to increase strength in silicone based polymers for anti-fouling/friction reduction coatings.

	FY 2005	FY 2006	FY 2007
MEDICAL/BIOLOGY	14,332	12,870	14,729

Efforts include: biosensors, biomaterials, bioprocesses; marine mammals; casualty care and management; fit and healthy force; casualty prevention; biorobotics; expeditionary operations training and education; and chemical-biological defense. Accomplishments and plans described below are examples for each effort category. Starting in FY 05, resources were realigned from this activity to fund Counter IED efforts in support of the Global War on Terrorism.

FY 2005 Accomplishments:

Medical Sciences
• Continued research to understand individual variability in stress response.
• Continued non-lethal weapons bioeffects research.
• Continued work on stress physiology, hyperbaric physiology, and biological effects of Naval operational exposures (e.g., directed energy).
• Continued work on genomics/genetic immunization for infectious organisms of military relevance and signal transduction.

Biological Sciences
• Continued studies of effects of noise on marine mammal hearing and behavior.
• Continued studies on fate and effects of energetic and other organic compounds in marine environments.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

- Continued research on virus-based nanoarchitectures.
- Continued work on microbial synthesis of energetic materials.
- Continued research on biofouling and biocorrosion.
- Continued studies of marine mammal biomimetic/biorobotic systems.
- Continued efforts to develop next-generation and supramolecular antibiotics.
- Continued development of genetically encoded markers of signal transduction.
- Continued work to power naval ocean instruments with sediment biofuel cells.
- Completed work on crystallization of light-emitting algae.
- Completed development of novel genetic transformation tools for marine algae and seaweeds.
- Completed studies of marine mammal biorobotic systems.
- Initiated research to understand physiological effects of Naval sonar exposures on marine mammals.

FY 2006 Plans:

Medical Sciences
- Continue all efforts of FY 2005 less those noted as completed above.
- Complete studies on fate and effects of energetic and other organic compounds in marine environments.

Biological Sciences
- Continue all efforts of FY 2005 less those noted as completed above.
- Complete studies of marine mammal biomimetic/biorobotic systems.
- Initiate studies of toxicity of Royal Demolition Explosive (RDX), High Melting Point Explosive (HMX) and Dinitrotoluene (DNT) in marine benthos.
- Initiate dolphin microarray and gene-based studies to facilitate immunobiology studies of stress response.

FY 2007 Plans:

Medical Sciences
- Continue efforts of FY 2006 less those noted as completed above.

Biological Sciences
- Continue efforts of FY 2006 less those noted as completed above.
- Complete research on virus-based nanoarchitectures.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

	FY 2005	FY 2006	FY 2007
OCEAN SCIENCES	83,344	81,786	88,059

Efforts include: Littoral Geosciences, Optics, and Biology; Marine Mammals; Physical Oceanography and Prediction; Ocean Acoustics; and University National Oceanographic Laboratory System (UNOLS). Accomplishments and plans described below are examples for each effort category. Starting in FY 05, resources were realigned from this activity to fund Counter IED efforts in support of the Global War on Terrorism.

FY 2005 Accomplishments:

Littoral Geosciences, Optics, and Biology
• Continued field programs to understand physical and biological processes responsible for the formation, maintenance, and breakdown of thin oceanographic layers which have a significant impact on undersea warfare sensors and weapons.
• Continued effort to improve accuracy of the "5-cm gravimetric geoid" and precise geodesy. (NRL)
• Continued effort to understand and predict coastal dynamics in environments where significant sediment heterogeneity occurs, impacting on hydrodynamic and morphodynamic processes, including six week, April-May, field efforts off Cassino Beach, Brazil, subject to sudden, large muddy beach deposits. (NRL)
• Completed development of techniques to exploit hyperspectral data from a geostationary platform to better understand coastal ocean dynamics. (Includes NRL investment/performance in this effort.)
• Developed better understanding of the extent and intensity of seafloor gas hydrate accumulations and coastal bio-optical response to air-ocean forcing. (Includes NRL investment/performance in this effort.)
• Initiated effort to use time sequencing NRL PHILLS (Portable Hyperspectral Imager for Low-light Spectroscopy) images of the same scene to derive dynamical properties of the ocean surface. (NRL)
• Initiated effort to investigate the use of combining Light Detection and Ranging and passive hyperspectral sensing to derive bottom characteristics and water column optical properties over water and terrestrial vegetation and trafficability maps over land. (NRL)

Marine Mammals
• Continued field trials of an integrative ecosystem study to provide environmental predictors of whale presence or absence to reduce impacts of Naval systems to marine mammals.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

Physical Oceanography and Prediction
• Continued to develop state of the art numerical model assimilation and initialization techniques, improved physical parameterizations, air-sea interactions, and fidelity for atmospheric and ocean prediction systems. (Includes NRL investment/performance in this effort.)
• Continued extensive internal wave field program off the New Jersey Shelf; field work will coincide with and compliment the Shallow Water Acoustics Program.
• Completed pilot program on topographic induced mixing in the Aegean Sea.
• Completed a workshop assessing the state-of-knowledge of “Rogue Wave” dynamics and prediction.
• Completed field studies of the Kuroshio Intrusions into the Ryuku Islands.
• Initiated an assessment of the role of emerging sub-mesoscale parameterization techniques for improving next generation high resolution/high accuracy environmental models.
• Initiated design evaluation for a persistent mobile sampling network based on autonomous undersea vehicle platform and sensor technologies.
• Initiated extensive 3-year field program on prediction of internal waves; Spring FY 05 field work in the South China Sea collected unique data sets on extremely large internal waves, acoustics in internal wave fields, transmission loss, and dissipation in areas of internal wave breaking.
• Initiated first field test of the Optimal Deployment Dri (ODDAS) in the South China Sea.
• Initiated 5-year program on the analysis of coherent structures in rivers and estuaries in support of the prediction and characterization of denied areas.
• Initiated an understanding of the bio-optical response to dynamical forcing processes and how to assimilate optical properties into a physical ocean model for predictive purposes. (NRL)

Ocean Acoustics
• Continued development of numerical methods to predict the effects of the sub-surface bubble layer on underwater acoustics propagation and scattering. (Includes NRL investment/performance in this effort.)
• Continued to research effect of solitons and internal wave bores on acoustic propagation and buoyancy. (Includes NRL investment/performance in this effort.)
• Continued incorporation of stochastic parameters into underwater acoustic propagation models. (Includes NRL investment/performance in this effort.)
• Completed development of the coupled hydrodynamic-acoustic model for sound generation from breaking waves. (Includes NRL investment/performance in this effort.)
• Initiated development of an improved Nonlinear Progressive Wave Equation model for shallow water applications. (NRL)

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Initiated comparison of numerical methods that predict effects of sub-surface bubble layers on acoustics to laboratory measurements. (NRL)

FY 2006 Plans:

Littoral Geosciences, Optics, and Biology
• Continue all efforts of FY 2005 less those noted as completed above.
• Initiate programs to estimate optical properties of coastal ocean water from above-surface sensing, using in-situ data for validation.

Marine Mammals
• Continue all efforts of FY 2005 less those noted as completed above.
• Initiate new efforts on tracking of marine mammals using data fusion based on tags and remote sensing.

Physical Oceanography and Prediction
• Continue all efforts of FY 2005 less those noted as completed above.
• Initiate field efforts for a persistent mobile sampling network based on autonomous undersea vehicle platform and sensor technologies.
• Initiate a field and modeling program to predict mesoscale structures and rapidly-varying currents in the Indonesian Archipelago using Synthetic Aperture Radar (SAR), Hyperspectral and other remote data together with new data assimilation methods.
• Initiate field programs that demonstrate “persistent monitoring and measurement of environmental structures using gliders.
• Initiate workshops to define science needs for Sea Basing.
• Initiate the field experiment in Monterey Bay to examine the role of unresolved processes in model parameterizations
• Initiate the development of breaking wave detection techniques using Hilbert transformation of the space-time series of surface waves and the capability of establishing empirical functions connecting wave breaking properties to the generation and entrainment of bubble clouds. (NRL)

Ocean Acoustics
• Continue all efforts of FY 2005 less those noted as completed above.
• Complete incorporation of stochastic parameters into underwater acoustic propagation models. (Includes NRL investment/performance in this effort.)

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Complete research on effect of solitons and internal wave bores on acoustic propagation and buoyancy. (Includes NRL undersea warfare investment/performance in this effort.)
• Complete development and comparisons with data of numerical methods to predict effects of sub-surface bubble layers on acoustic propagation and scattering. (NRL)
• Initiate studies of adaptive beam-forming using mobile, autonomous sensors.
• Initiate numerical simulations to investigate the analogs of condensed matter physics phenomena in ocean acoustics. (NRL)
• Initiate development of realistic seismo-acoustic model for sediment geology. (NRL)
• Initiate investigation of acoustically induced magnetic fields using modern experimental equipment and numerical techniques. (NRL)
• Initiate development of source waveform design for rough littoral seafloors. (NRL)
• Initiate development of "time-reversal" characterization of bubble field dynamics. (NRL)
• Initiate modeling of uncertainty in pressure field due to sound speed field uncertainty for a canonical shallow water waveguide using polynomial chaos and Bayesian methods. (NRL)

Ocean Class Research Vessel- $4,000
• Initiate assessment of optimum hull forms for Ocean Class platform/craft oceanographic research mission.
• Initiate assessment of novel mission equipment options to ensure technology infusion.
• Initiate preliminary and detailed design studies of the selected hull form.
• Initiate a review and prioritize science mission requirements in conjunction with oceanographic research community and University National Oceanographic Laboratory System (UNOLS) members.
• Initiate program management.

FY 2007 Plans:

Littoral Geosciences, Optics, and Biology
• Continue all efforts of FY 2006.
• Initiate incorporation of improved understanding of tropospheric and stratospheric bulk exchanges, air-sea interface, boundary layer interface, coastal ocean dynamics, gas hydrate accumulation, and biological responses into atmospheric and ocean prediction models and tactical aids. (Includes NRL investment/performance in this effort.)

Marine Mammals
• Continue all efforts of FY 2006.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Complete study of an integrative ecosystem study to provide environmental predictors of whale presence or absence to reduce impacts of Naval systems to marine mammals.

Physical Oceanography and Prediction
• Continue all efforts of FY 2006.
• Initiate a Coupled Oceanographic-Acoustics modeling and field program to demonstrate the use of a fully coupled system in optimizing tactical reduction of uncertainty.
• Initiate an integrated modeling and field experiment on determining custom self-learning wave databases and forecast systems/ship-movement and engineering systems for Sea Basing.
• Initiate the pilot test of the novel data (synthetic aperture radar and Hyperspectral) assimilation forecast system developed under Indonesian experiment.
• Initiate an Estuarine-Littoral Processes Interaction field study.

Ocean Acoustics
• Continue all efforts of FY 2006 less those noted as completed above.
• Complete development of the Nonlinear Progressive Wave Equation model. (NRL)
• Complete investigations of analogs of condensed matter physics phenomena in ocean acoustics. (NRL)
• Initiate assessment of “time-reversal” propagation techniques for mitigation of environmental variability.
• Initiate field work on adaptive beamforming using mobile, autonomous sensors.

	FY 2005	FY 2006	FY 2007
SCIENCE AND ENGINEERING EDUCATION, CAREER DEVELOPMENT AND OUTREACH	39,837	35,140	37,736

Science and Engineering Education and Career Development activities include DON participation in science fairs, summer research interns/fellows at Navy laboratories, graduate fellowships for individuals expected to become members of the engineering faculty at Historically Black Colleges and Universities and Minority Institutions (HBCU/MIs), and curricular enrichment programs. Outreach includes the encouragement, promotion, planning, coordination and administration of Naval Science and Technology. Starting in FY 05, resources were realigned from this activity to fund Counter IED efforts in support of the Global War on Terrorism.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

FY 2005 Accomplishments:

- Continued awarding prizes at 400 regional high school science fairs and three national competitions.
- Continued supporting 230 students as summer research interns at Navy laboratories.
- Continued providing graduate fellowship support to nine HBCU engineering faculty candidates.
- Continued funding Young Investigator research grants including 28 new three-year research grants.
- Continued the encouragement, promotion, planning, coordination and administration of naval Science and Technology.

FY 2006 Plans:

- Continue all efforts of FY 2005.

FY 2007 Plans:

- Continue all efforts of FY 2006.

	FY 2005	FY 2006	FY 2007
SENSOR, ELECTRONICS AND ELECTRONIC WARFARE (EW)	46,063	47,312	45,454

Efforts include: Sensing, diagnostics, and detectors; navigation and timekeeping; nano-electronics; wide band gap power devices; real-time targeting; Electro-Optical/Infra Red (EO/IR) electronics; EO/IR electronic warfare; EO/IR sensors for surface/aerospace surveillance; Radio Frequency (RF) sensors for surface/aerospace surveillance; solid state electronics; vacuum electronics; Advanced Multi-Function RF System (AMRFS); and RF electronic warfare. Starting in FY 05, resources were realigned from this activity to fund Counter IED efforts in support of the Global War on Terrorism.

FY 2005 Accomplishments:

- Continued effort to incorporate non-equilibrium considerations into modeling of realistic superconducting tunnel junctions when barrier is near the metal/insulator transition.
- Continued to explore optical super resolution techniques with atmospheric turbulence reduction techniques.
- Continued investigation of temporal-spatial sampling circuits and architectures for digital-to-analog conversion.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

- Continued to improve room temperature 4.5-4.8 micron quantum cascade laser by reducing emission wavelength and further increasing power to meet laser source requirements for infrared countermeasures against heat-seeking missiles.
- Continued advanced height finding and detection algorithms for high frequency radar.
- Continued project to develop linear higher power microwave wide bandgap semiconductor bipolar transistors based on distributed polarization effect (graded composition) base growth and processing technology.
- Continued the evaluation and assessment of hardware-compatible space-time algorithms for Digital Science Process Scenario (DSP) applications to Transmit/Receive (T/A) arrays.
- Continued comprehensive study of compressive and tensile strain patterned semiconductor quantum wells using micromachining. (NRL)
- Continued proof of principle demonstration of microcavity chemical sensor. (NRL)
- Continued invention of a new technique for micromachining quantum wells using InAlGaAs (Indium Aluminum Gallium Arsenide) barriers. (NRL)
- Continued achievement of >1% power conversion efficiency in an organic plastic solar cell based on C60 and a transparent hole transporter, and a conducting polymer electrode.
- Continued demonstration of mid-IR type-II "W" laser diodes with record external quantum efficiencies (49% at 78K). (NRL)
- Continued development of technique that suppressed the formation of “killer” GaSb (Gallium Antimonide) pyramid defects in antimonide superlattice growth. (NRL)
- Continued demonstration of optical coherence in mid-IR 2DDFB (Two Dimensional Distributed Feedback) lasers with record beam quality for very broad stripes - e.g., 4 times the diffraction limit at w = 400 microns. (NRL)
- Continued development of Adaptive Pulse Compression and Adaptive Pulse Compression Repair Algorithms, which unmask small targets in the presence of large targets and are vastly superior to conventional pulse-compression methods. (NRL)
- Continued efforts in radiation effects studies to determine suitability of electronic components for space application. (NRL)
- Continued the design and fabrication of high performance silicon oscillators.
- Continued creation of techniques for guiding and transporting cooled and trapped rubidium atoms through hollow waveguides. (NRL)
- Continued the knowledge base for multi-phase array space-time sampling demonstrating that the spectral band can be doubled at no cost in element density for the linear array and for 15% more elements in the planar case.
- Continued research to extend and implement Magnetic Resonance Elastography for low spin density materials.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

(NRL)
• Continued development of Nyquist limits for multi-phase array sampling in 4-D spacetime for linear arrays and formulated the problem for planar arrays.
• Continued further development of microcavity gas sensor.
• Continued testing oscillator sources with delay in laser experiments and initiated synchronization study in coupled fiber lasers. (NRL)
• Continued space-time sigma-delta's algorithmic compatibility with matrix-feedback filter structures that will reduce required computation by an order of magnitude. Investigate spectral shaping of errors due to RF hardware mismatch. (NRL)
• Continued analysis of very low frequency oscillations, caused by the interaction between the transistor and one of the capacitors in the circuit and develop a theory based on singular perturbation theory to explain the origin of these oscillations as a switching between 2 coexisting high frequency states. (NRL)
• Continued determining the radiation-hardening mechanisms related to silicon nanoclusters in oxides. (NRL)
• Continued optimizing power and efficiency of high power, electron beam pumped argon-xenon (Ar-Xe) laser for Navy compact Defense Early Warning (DEW). (NRL)
• Continued synchronization analysis in coupled fiber experiments. (NRL)
• Continued numerical scattering simulations of canonical objects undergoing micro-motion dynamics and compare the results with the Doppler modulations observed. (NRL)
• Continued suite of semiconductor multilayer and superlattice based infrared (IR) sources and sensors in 3-5 micron range.
• Continued exploitation of atom condensates to reach physical limit of frequency precision and control.
• Continued development of bipolar wide bandgap semiconductor linear amplifiers.
• Continued the analysis and characterization of micro-motion Doppler modulation.
• Continued investigation of extension of interference model and adaptive structures to produce waveforms that are transparent to non-users.
• Continued research into the bulk thermodynamic properties of phononic crystals.
• Continued investigations of the modification of metal surfaces by nitriding and other processes to maximize hardness, wear and corrosion resistance for Navy gun barrel applications using the Large Area Plasma Processing System (LAPPS). (NRL)
• Completed tests of the ability of superconducting Analog to Digital Converters (ADC) to allow digital recovery of two distinct signals of arbitrary bandwidth (BW) from a wide spectral analog band with the same clarity as a tuned bandwidth ADC (already proven for case of a single signal in the band).
• Completed investigation of the electromagnetic impulse response of radar targets and invented a de-convolution technique that greatly improves radar resolution. (NRL)

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

- Completed research to determine feasibility of locking a laser and etalon to precision frequency standards and generate stable reference optical and microwave frequency lines across a broad spectrum. (NRL)
- Completed investigation of piezoelectric effects in micromachined quantum wells.
- Completed increasing the performance of device power conversion efficiency of organic solar cells by optimizing overlap with solar spectrum using highly absorbing dyes and nanocrystals.
- Completed development of Inverse Boundary Element methods to reconstruct sources of off-board radiated acoustic pressures. (NRL)
- Completed study to understand the ultimate performance (highest possible Q) of intermediate scale silicon oscillators. (NRL)
- Initiated investigation of superresolution signal processing techniques for closely spaced and unresolved targets in Doppler, range and direction of arrival spaces for a variety of radars.
- Initiated non-cooperative target identification from multiple aspects.
- Initiated investigation of ultra high speed logic and multiple-quantum-well devices with a goal of >500 giga-hertz (GHz) samplers, in support of ADC, for advanced multifunction RF systems.
- Initiated investigation of physical basis for improved time and frequency standards using quantum-entangled ions and atoms.
- Initiated project to explore physical behavior of full arrays of nanoscale devices for logic, memory, and imaging, with a first step being the integration of Cellular Nonlinear Network (CNN) fast image processor with multi-spectral focal plane array sensors.
- Initiated exploration of functioning of sensitive miniature fluxgate magnetometers.
- Initiated experimental investigations into the bulk thermodynamic properties of photonic crystals. (NRL)
- Initiated investigations into developing highly radiation-tolerant electronic/optoelectronic devices from nanocrystals and quantum dots. (NRL)
- Initiated experiments and collecting fundamental data to study electromagnetic scattering from canonical objects undergoing micro-motions. Expand study of mathematical solutions of micro-motion induced Doppler modulations. (NRL)
- Initiated the synthesis and modeling of tailored response magneto-dielectric materials. (NRL)
- Initiated the development of multistatic interference models and resulting adaptive processing structures. (NRL)

- Initiated experiments on explosive and human (proxies) to determine reflectivity and time domain responses. Investigated and simulated imaging configurations based on current radar technologies and potential processing schemes. (NRL)

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Initiated methods for preparation, functionalization and characterization of Silicon Carbide and Gallium Nitride (Sic and GaN)nanowire surfaces. (NRL)

FY 2006 Plans:

• Continue all efforts of FY 2005 less those noted as completed above.
• Complete development of Magnetic Resonance Elastography to characterize low spin density materials. (NRL)
• Complete determination of the feasibility of quantum cascade 2DDFB lasers with enhanced power and a high-quality beam. (NRL)
• Complete patterning of GaN photonic crystal devices on Silicon. (NRL)
• Complete the evaluation and assessment of hardware-compatible space-time algorithms for DSP applications to T/R arrays.
• Initiate monolithic integration of multifunctional materials to enable passive devices and sensors into wide bandgap semiconductor circuits.
• Initiate program to extend device physics and architectures to frequencies approaching tera hertz (THz).
• Initiate program to incorporate Magnesium Diboride (MgB2) and related intermediate temperature superconductors into active electronic device structures.
• Initiate development of stabilized optical sources and low-noise photodetectors for the fabrication of an ultrastable microwave-frequency source. (NRL)
• Initiate determination of whether the coupling between spins in quantum dots mediated by the virtual excitions is sufficiently strong for use in solid state implementations for quantum information.
• Initiate development of a blind adaptive beamforming approach for the HF radar case and compare with both the conventional and traditional approaches. (NRL)
• Initiate improvements to integrated nanomechanical device arrays to include scaling down resonator architecture and quantifying properties which establish phononic crystal properties. (NRL)
• Initiate development of electromagnetic ultra-near-field holography. (NRL)
• Initiate study to determine if the coupling between spins in quantum dots mediated by the virtual excitons is sufficiently strong for use in solid state implementations for quantum information. (NRL)
• Initiate development of approaches for probability of detection for deterministic signals in stationary noise and quantify for non-stationary noise. (NRL)

FY 2007 Plans:

• Continue all efforts of FY 2006 less those noted as completed above.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

• Complete suite of semiconductor multilayer and superlattice based infrared (IR) sources and sensors in 3-5 micron range.
• Complete exploitation of atom condensates to reach physical limit of frequency precision and control.
• Complete development of bipolar wide bandgap semiconductor linear amplifiers.
• Complete the analysis and characterization of micro-motion Doppler modulation.
• Complete investigation of extension of interference model and adaptive structures to produce waveforms that are transparent to non-users.
• Complete research into the bulk thermodynamic properties of phononic crystals.
• Complete investigations of the modification of metal surfaces by nitriding and other processes to maximize hardness, wear and corrosion resistance for Navy gun barrel applications using the large area plasma processing system (LAPPS). (NRL)
• Complete analysis and characterize observed micro-motion features and components obtained in experiments. Create a framework for analysis of Doppler modulations (NRL)
• Initiate program to apply innovative mass nanofabrication techniques to previously developed nanodevice arrays.
• Initiate investigation of temporal-spatial noise shaping circuits and architectures for analog-to-digital conversion.
• Initiate study of the feasibility of a solid state implementation of a quantum computer. (NRL)

	FY 2005	FY 2006	FY 2007
WEAPONS	7,365	8,502	9,638

Efforts include: Undersea Weaponry; Energetic Materials and Propulsion; Expeditionary Operations; and Directed Energy. Accomplishments and plans described below are examples for each effort category. Starting in FY 05, resources were realigned from this activity to fund Counter IED efforts in support of the Global War on Terrorism.

FY 2005 Accomplishments:

Undersea Weaponry
• Continued conducting basic research related to critical S&T (including vehicle control, maneuverability, and stability) associated with the development of high-speed supercavitating vehicles (HSSV).
• Continued expansion of the University Laboratory Initiative (ULI) Program to provide a further infusion of educated and career-minded scientists and engineers in support of the National Naval Responsibility (NNR) for

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

Undersea Weapons Research.
• Initiated computer code refinements and investigation of supercavitating vehicle dynamics and instability.

Energetic Materials and Propulsion
• Continued development of a fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus.
• Continued to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications.
• Continued to develop spectroscopic capabilities to accurately determine aluminum combustion characteristics in various oxidizing environments.
• Continued to develop synthesis routes to difluoramino-based and organometallic-based highly energetic ingredients.
• Continued exploring the use of quantum mechanics and molecular dynamics to provide fundamental properties for energetic materials to predict initiation/detonation criteria for insensitive munitions applications.
• Completed work on quantification of active combustion control.
• Initiated efforts to explore alternative fuel concepts for Naval applications to include hydrogen, synthetic diesel, and biodiesel.
• Initiated development of multi-parameter sensor for multi-phase combustion flows (UAV and underwater Pulse Detonation Engine (PDEs)).
• Initiated investigation of JP-10 combustion-based Proton-Exchange-Membrane (PEM) fuel cells.
• Initiated investigation of multi-tube multi-nozzle PDEs and multi-tube common nozzle PDEs.
• Initiated investigation of nanometallic-hydrocarbon hybrid catalytic combustion for increased energy release rates.
• Initiated investigation of novel initiation techniques, optimize injection parameters, and demonstrate integrated single tube operation for PDEs.
• Initiated PDM II Advanced Energetics research in reactive, explosive, and propulsive energetic materials, including high energy ingredient synthesis & characterization, and fundamentals of initiation and decomposition mechanisms, to tailor energy release processes in order to achieve substantial performance gains and/or enhanced survivability in harsh environments.

Expeditionary Operations
• Initiated investigation of modeling and exploiting the nonlinear seismic interactions between buried land mines and their surrounding soil for purposes of landmine detection.
• Initiated investigation of catalysts that reduce the pre-processing requirements for using logistic fuels

in solid oxide fuel cells.
• Initiated investigation of optimal efficiency for generation of electrical energy from human motion.

FY 2006 Plans:

Undersea Weaponry
• Continue all efforts of FY 2005 less those noted as completed above.
• Initiate evaluation of viable synthesis methodologies and characterize emerging underwater explosive ingredients.
• Initiate development of diagnostic capabilities to accurately determine aluminum combustion characteristics in oxidizing environments.

Energetic Materials and Propulsion
• Continue all efforts of FY 2005 less those noted as completed above.
• Initiate implementation of new & nanostructured materials design concepts for direct energy conversion and waste energy conversion.
• Initiate investigation of integrated pulse detonation engine-airframe for autonomous vehicles, and pulse detonation for passive weapons (noise, jamming).

Expeditionary Operations
• Continue all efforts of FY 2005.

Directed Energy
• Initiate research thrust in Directed Energy weapons.

FY 2007 Plans:

Undersea Weaponry
• Continue all efforts of FY 2006 less those noted as completed above.
• Initiate studies to determine the best investment of technologies for Unmanned Undersea Vehicle (UUV) Guidance and Control (G&C).

Energetic Materials and Propulsion
• Continue all efforts of FY 2006 less those noted as completed above.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

- Initiate development of PDE for underwater applications.

Expeditionary Operations
- Continue all efforts of FY 2006.

Directed Energy
- Continue all efforts of FY 2006.

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ACADEMY FOR CLOSING AND AVOIDING ACHIEVEMENT GAPS	963	0

Research and Development for: (1) systemic mentoring, including research participation, of 50-100 undergraduate college Science, Technology, Engineering, and Mathematics students known as scholars, (2) extensive educational enrichment services for 150-200 K-12th grade students during summer, and (3) conducting research, publishing, and delivering presentations and workshops for the community at large.

FY 2005 Accomplishments:
- Enabled 30 undergraduate scholars to conduct research at laboratories around the country.
- Enabled 18 undergraduate scholars to attend two national conferences (those of HBCU-Undergraduate Program and of the National Society of Black Physicists (NSBP)) and 30 pre-college students to attend the National Conference of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE).
- Enabled 48 Elementary and Middle and 66 High School students to partake in the Summer Academic Enrichment Programs identified above.

	FY 2005	FY 2006
BIO-INSPIRED MATERIALS - APPLICATIONS IN CATALYSIS, MAGNETICS, ELECTRONICS AND MEDICINE	0	1,400

This effort supports bio-inspired materials - applications in catalysis, magnetics, electronics and medicine research.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

	FY 2005	FY 2006
BRAIN-BASED INTELLIGENT SYSTEM	1,929	0

Investigated the design of embedded low-power, self-instructing computational systems through architecture studies, analysis, and experimentation. If the research is successful, with subsequent development, these systems could be utilized for Navy applications that could improve human performance, increase training capabilities, and enhance human communication. The design of the proposed computational device is based on the emulation of neuroanatomy and the dynamics known to be present in the brain.

FY 2005 Accomplishments:

• Explored the circuit architectures of an array of neural cores which will replicate the functional elements of the brain and its interconnectivities. Configure these architectures to respond to a variety of signals without the need for prior specific programming or instruction.

	FY 2005	FY 2006
CARBON NANOTUBE-BASED RADIATION-HARD NON-VOLATILE RAM	0	7,000

This effort supports carbon nanotube-based radiation-hard non-volatile RAM research.

	FY 2005	FY 2006
CENTER FOR PHOTOCHEMICAL SCIENCES	0	1,000

This effort supports the Center for Photochemical Sciences.

	FY 2005	FY 2006
ENERGETICS S&T WORKFORCE REVITALIZATION INITIATIVE	0	2,800

This effort supports the Energetics S&T Workforce Revitalization Initiative.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

	FY 2005	FY 2006
FACIAL RECOGNITION TECHNOLOGY RESEARCH AND DEVELOPMENT	1,543	0

Research and Development of facial recognition technology for security application at entry locations on US military bases and facilities.

FY 2005 Accomplishments:

• Conducted research to combine advanced face recognition technology with a novel skin texture metric in order to develop a highly accurate and robust face biometric to verify the identity of personnel entry in a DoD facility.

• Validated research by measuring accuracy and speed of this technology for identification of personnel within vehicles who enter a smart gate.

	FY 2005	FY 2006
HYDROGEN FOR FUEL CELLS	966	0

Research into hydrogen generation for use as fuel for electricity production by environmentally-friendly fuel cells.

FY 2005 Accomplishments:

• Conducted efforts to design, implement and test new catalysts for hydrogen evolution from alcohols and other biofeedstocks under ambient conditions of temperature and pressure.

	FY 2005	FY 2006
INTELLIGENT AUTONOMOUS NETWORKS AND SYSTEMS PROGRAM (AD HOC DATA COMMUNICATIONS)	969	1,000

Commercialization of Ad Hoc Routing Protocols to develop an initial product capability delivering a network connection device for Class 2 UAV platforms within 18 months. This communication system will be positioned to support multiple types of Unmanned Vehicles.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

FY 2005 Accomplishments:

• Conducted commercialization of Ad Hoc Routing Protocols to develop an initial product capability delivering a network connection device for Class 2 UAV platforms.

FY 2006 Plans:

• This effort supports intelligent autonomous networks and systems program (Ad hoc data communications) research.

	FY 2005	FY 2006
NANOELECTRONICS AND NANOMETROLOGY INITIATIVE	0	2,500

The effort supports the Nanoelectronics and Nanometrology Initiative.

	FY 2005	FY 2006
NAVY USE OF UNOLS SHIPS	0	4,250

This effort supports Navy use of UNOLS ships research.

	FY 2005	FY 2006
NEUROBIOLOGICALLY INSPIRED COMPUTATIONAL ARCHITECTURES AND METHODOLOGIES	0	1,400

This effort supports neurobiologically inspired computational architectures and methodologies research.

	FY 2005	FY 2006
ROTATIONAL MOLDED DOUBLE WALL HULL USING THERMO-PLASTIC CROSSLINK MATERIAL	0	1,250

This effort supports rotational molded double wall hull using thermo-plastic crosslink material research.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

	FY 2005	FY 2006
UNOLS RESEARCH VESSEL	1,737	2,000

Acoustical studies in the Littoral zone have been seriously hampered by interference from noise caused by shipboard machinery and propulsion equipment and radiated through the hull of the vessel. At the present there are no United States research vessels which meet the International Council for Exploration of the Seas (ICES) 209 standard (radiated noise standard for research vessels). UNOLS vessels have been extensively used by NRL and ONR funded investigators to conduct such studies. This funding was used to augment the propulsion and machinery quieting for the University of Delaware vessel presently under construction in order to provide enhanced capability for Navy investigators.

FY 2005 Accomplishments:

• Conducted efforts to identify potential noise sources and implement ameliorating strategies to meet ICES standards.

FY 2006 Plans:

• This effort supports the UNOLS research vessel.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0601152N In-House Laboratory Independent Research
PE 0601103N University Research Initiatives

NON-NAVY RELATED RDT&E:
PE 0601102A Defense Research Sciences (Army)
PE 0601101E Defense Research Sciences (DARPA)
PE 0601102F Defense Research Sciences (Air Force)

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N
PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
POWER PROJECTION APPLIED RESEARCH	153,897	135,454	84,914	67,205	71,966	71,780	72,005

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This PE emphasizes near to mid-term transition opportunities by developing and demonstrating technologies supporting the Future Naval Capability (FNC)/Program Enabling Capabilities (ECs) for Marine and Unmanned Vehicle Tactical Intelligence, Surveillance and Reconnaissance (ISR), Advanced Naval Fires Technology, Hostile Fire Detection and Response, and Dynamic Target Engagement & Enhanced Sensor Capabilities. Within the Naval Transformation Roadmap, this investment will achieve two of four key transformational capabilities required by Sea Strike as well as technically enable the Littoral Sea Control key transformational capability within Sea Shield.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N
PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	135,163	94,148	73,926
Congressional Action	0	42,750	0
Congressional Undistributed Reductions/Rescissions	-107	-1,444	0
Execution Adjustments	8,608	0	0
Federal Technology Transfer	-35	0	0
FY 2005 SBIR	-2,494	0	0
Program Realignment	0	0	10,936
Rate Adjustments	0	0	52
Realignment of EM Railgun from PE 0603123N	12,762	0	0
FY 2007 President's Budget Submission	153,897	135,454	84,914

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
This PE is focused on 6.2 applied research. As such it develops early components technologies that if successful can be integrated into weapon systems that meet warfighter requirements. Most of the work in this PE can be classified between Technology Readiness Level (TRL) 2 (technology concept and/or application formulation) and TRL 4 (component and/or breadboard validation in laboratory environment). The metrics used

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N
PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH

to evaluate 6.2 programs are necessarily less precise than those used in 6.3 programs.

The metrics for this PE can be divided into two categories: technological and organizational/functional. Technological metrics address the success of the work performed. The primary technological metrics used in this PE involve laboratory experiments/tests demonstrating proof of the concept for the technology. This demonstration is frequently a hand-assembled functioning breadboard of the concept. The organizational/functional metrics applied to this PE include: transition of the technology to advanced development in a 6.3 PE and applicability of the technology to documented warfighter problems or requirements. Successful implementation of these categories would result in the application of a pass/fail metric and further evaluation for possible transition to a 6.3 development/demonstration program.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
POWER PROJECTION APPLIED RESEARCH	115,714	87,704	84,914	67,205	71,966	71,780	72,005

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses the technology issues involving the Navy's capability to project naval power on the broad seas and in the littoral regions.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
STRATEGIC SUSTAINMENT	28,199	22,942	13,580

The Strategic Sustainment activity develops technologies which will sustain and improve Navy's strategic system capabilities in the areas of Radiation Hardened System Design (RAD HARD), Solid Rocket Motor Ignition (SRM) Response, and drag reduction devices. This activity contains the Technology for the Sustainment of Strategic Systems (TSSS) and the Strategic Systems Infrastructure (SSI) effort.

Decreases in FY 2006 and FY 2007 are due primarily to completion of TSSS Phase 1 effort. The FY 2007 $10M reduction is due to the completion of the TSSS portion of the program and the reduction in the last year of the SSI portion of the program.

FY 2005 Accomplishments:

- TSSS: Completed RAD HARD System Design Tool task. The SRM ignition response effort completed code validation and verification with flight test data. The Drag Reduction Devices task completed the development of an aero elasticity tool for performance prediction of missiles with drag reduction devices. Successfully completed New Technology Gyro, Micro-Thermal Control (MTC), Silicon Oscillating Accelerometer (SOA) and transitioned all three to SSP Fiber Optic Gyro Navigation (FOGN). Initiated development of Atom Interferometer

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

Gravity Gradient (AIGG) for real time measurement of vertical deflection (VD) and gravity anomalies for use in non-gravity mapped areas.
- SSI: Continued Missile propulsion effort with subscale static motor testing. Post Boost Control System (PBCS) developed thermal/mechanical valve and flow impingement models. Ordnance Initiation technology effort conducted design reviews and purchased and tested prototype sub-assemblies for evaluation. Missile electronics continued the model development. Navigation Sonar initiated trade studies and design of new technology sensors.

FY 2006 Plans:

- TSSS: Underwater launch task will conduct exit testing of the Underwater Launch Technology Sustainment System (ULTSS). Testing will be performed to demonstrate the utility of the ULTSS in guiding and advising engineers unfamiliar with Underwater Launch (UWL) technology in the creation of a conceptual design. Release of final version of ULTSS. Complete fabrication and test prototype Atom Interferometer Gravity Gradient (AIGG) sensor using the exit criteria. If successful, transfer to SSP program. The TSSS Phase I effort is completed.
- SSI: Missile tasks in Propulsion will continue efforts by conducting non-eroding throat tests, chamber bottle tests, insulator tests, component compatibility tests and propellant hazard assessment. The program will conduct an innovative testing of new rocket motor case/nozzle design. Continue Advanced PBCS Valve efforts by conducting materials compatibility tests, an Integrated Valve Assembly demo, subscale propellant mixes and a manifold concept demo. Ordnance Initiation Technologies program will integrate various sub-assemblies and perform laboratory testing on various prototype designs. Continue Missile Electronics efforts by conducting small coupon aging studies, conduct radiation hardening tests & assessments, complete board aging model development, and continue development of board level and missile level modeling techniques. Sonar effort will complete detailed design and begin fabrication of the prototype new technology hardware.

FY 2007 Plans:

- SSI: Continue Missile propulsion efforts by conducting larger scale non-eroding throat tests, chamber bottle tests, insulator tests, component compatibility tests and propellant hazard assessment. Continue Advanced PBCS Valve Technology and Materials program efforts by conducting materials compatibility tests, Integrated Valve Assembly demo, subscale propellant mixes and a manifold concept demo. Goal is heavy wall testing simulating a very limited full scale Post Boost control system test. Ordnance Initiation Technologies program will refine the design and perform tests on the prototype demonstrating and documenting new ordnance

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

initiation technology that meets the requirements. The Missile Electronics Technologies program completes code development with final Validation and Verification of the models with experimental radiation hard data and aging data. Navigation sonar will complete Laboratory and tank testing of the new technology transducer and hydrophones. Prototype hardware will be integrated aboard USNS WATERS to provide a Navigation Sonar System (NSS) test bed and evaluated at-sea in an operational environment.

	FY 2005	FY 2006	FY 2007
HIGH SPEED PROPULSION AND ADVANCED WEAPON TECHNOLOGIES	34,166	16,841	14,266

The work in this activity supports technologies that support high speed weapons delivery and advanced weapons development. High speed weapons (Mach 3 to Mach 6+) will provide the Navy the capability to attack time critical targets by delivering a weapon over long distances in very short periods of time.

The decrease in FY 2006 reflects conclusion of HyFly 6.2 work, reduced 6.2 effort in National Aerospace Initiative High Supersonic Turbine Vehicle (NAI HSTV), and transfer of Non-Lethal Weapons to PE 0602651M.

The decrease from FY 2006 to 2007 is a result of the reduced 6.2 funding for the High Speed Turbine program which is transitioning to a predominantly 6.3 flight demonstration program.

FY 2005 Accomplishments:

- HyFly: Completed HyFly related applied research. Completed development of high temperature ceramic matrix materials meeting projected Mach 6 thermal environment. Program fully transitions in FY 2006 to a series of flight demonstrations in PE 0603114N.
- Integrated High Payoff Rocket Propulsion Technology (IHPRPT): Completed Phase II air-to-air development of heavy weight motor. Demonstrated survivable nozzle and composite case for air-to-air rocket motor. Initiated development of new energetic materials for Phase III advanced composite rocket motor. Continued development of surface launch component technologies.
- Asymmetric Threat Defense: Continued development of detection and continuous target tracking algorithms. Demonstrated warhead effects on aluminum hull boats.
- National Aerospace Initiative High Supersonic Turbine Vehicle (NAI HSTV): Continued development and validation of flow path and turbine engine components and continue component rig testing. Began design of airframe components and assessment of thermal management techniques.
- Non-Lethal Weapons: This program has been transferred to PE 0602651M.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

FY 2006 Plans:

- IHPRPT: Complete and demonstrate Phase II performance goals using an air-to-air flight weight motor. Continue formulation and scale up of new propellants that will meet Phase III goals. Continue development of surface launch component technologies.
- Asymmetric Threat Defense: Demonstrate dual mode warhead effectiveness in both above and below water detonations. Demonstrate Electro-Optic (EO) guidance processing algorithm performance to detect small boats in clutter environment and to maintain track of closely spaced boats.
- NAI HSTV: Continue development of component/subsystem technologies in propulsion, inlet, nozzle, airframe, and thermal management for high supersonic turbine powered weapon systems. Select technologies for validation and conduct ground testing/validation.

FY 2007 Plans:

- IHPRPT: Initiate demonstration of air-to-air system that uses new energetic ingredient compositions to meet Phase III IHPRPT performance goals. Continue development of surface launch component technologies.
- NAI HSTV: Continue development of component/sub-system technologies for high supersonic turbine powered weapon systems. Conduct validation, ground testing and demonstrations.
- Asymmetric Threat Defense: Complete EO guidance processing and dual mode warhead efforts. Initiate identification of reactive material target interaction phenomenology, and development of lethality model. Initiate adaptive warhead technology development for air dominance and strike weapons, low cost miniaturization of guidance and control and propulsion control technologies. Continue development of propulsion and high temperature materials technologies to enable high speed weapons.

	FY 2005	FY 2006	FY 2007
UNMANNED VEHICLES	8,695	6,335	0

The focus of this activity is on those technologies that relate to the development of Unmanned Vehicles (UVs) that will support Naval forces and expeditionary operations. Specific technology areas include the development of Intelligent Autonomy (IA) technologies to increase autonomy, performance, and affordability in Unmanned Underwater Vehicles (UUVs), Unmanned Air Vehicles (UAVs), Unmanned Ground Vehicles (UGVs), UAV control systems, UAV radar systems, and UAV propulsion and power systems. Naval Research Laboratory (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

investment/performance is included in this effort through FY 2006.

FY 2007 reflects the transition of Autonomous Operations (AO) efforts to PEs 0602747N and 0603114N.

FY 2005 Accomplishments:

-IA: Continued development of dynamic replanning and autonomous control technologies (this effort transitioned to PE 0603114N in FY 2006). Conducted simulation of dynamic replanning and multi-vehicle technology for littoral Intelligence Surveillance and Reconnaissance (ISR). Completed simulation demonstration of multi-vehicle distributed cooperative control jointly with Air Force for Intelligence Surveillance and Reconnaissance (ISR) and strike missions. Completed joint DARPA UAV/UGV reconnaissance demonstration.
- UUV: Continued development and transition of UUV-deployed ISR Electro-Magnetic/Electro-Optic (EM/EO) sensors and software, multi-vehicle Undersea Search and Surveillance (USS) and communication link development; continued Magnesium Semi-Fuel Cell energy source development and demonstration. Completed preparation of transition data package for the Integrated Motor Propulsor (IMP).
- UAV control: Continued development of command, control and displays for multiple UAVs, and single frequency multi-point UAV communications. Continued shipboard UAV landing aid research.
- UAV propulsion: Continued development of XTE-67/A1 advanced turbine gas generator core effort.
- Autonomous Mobile Platform (AMP): Integrated energy replenishment and storage with a mobile platform and demonstrated replenishment and relocation operation.
- Integrated energy replenishment and storage mechanism in small autonomous vehicles and demonstrated replenishment and relocation. (NRL)
- Continued development of small autonomous mobile vehicles that can replenish their energy supply. Achieved controlled sustained flight of a flapping-wing, flying/crawling expendable countermeasure (CM) micro vehicle and successfully tested sailing and flight modes of an expendable airplane/sailboat, mobile, Electronic Warfare (EW) sensor platform. (NRL)
- Completed development of high performance EO/IR sensors for UAV's. (NRL)
- Initiated development of a lightweight, 4.5hp, recuperated, turbo-shaft engine with an integral 3 kW generator for UAV propulsion and portable power generation. (NRL)

FY 2006 Plans:

- IA: Complete development of multi-vehicle cooperation technologies. Complete medium-fidelity simulation of

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

multi-vehicle cooperation technologies. Transition efforts to PE 0603114N in FY 2007.
- UUV: Complete Undersea Search and Surveillance (USS) and Communications Navigation Aid (CNA) efforts through transition to PMS-Explosive Ordnance Disposal (EOD) and ONI-34; Complete Submarine Track and Trail (STT) efforts in advanced undersea sensors, communications, and autonomy. The STT UUV Technology efforts transition to PE 0602747N in FY 2007 due to EC realignments.
- UAV control: Continue development of airborne and shipboard battle manager platforms for UAVs and the airborne control station for control of multiple UAVs. Initiate investigation on integration of the Landing Period Designator (LPD) algorithms and system into air wake tracking system for autonomous shipboard recovery of UAVs. This effort will transition to PE 0603114N in FY 2007.
- UAV propulsion: Continue development of XTE-67/A1 demonstrator engine and demonstration of Integrated High Performance Turbine Engine technology (IHPTET) Joint Technology Demonstrator Engine (JTED) components. Transition to PE 0603114N in FY 2007.
- Continue development of small autonomous mobile vehicles. FY 2007 effort reflected in Navigation, Electro Optic/Infrared (EO/IR), and Sensor Technologies activity. (NRL)
- Continue development of lightweight UAV engine. FY 2007 effort reflected in Navigation, Electro Optic/Infrared (EO/IR), and Sensor Technologies activity. (NRL)
- Initiate design and development of a disposable micro air vehicle (MAV) which will enable the airborne delivery and precision placement of miniature EW sensors and payloads. FY 2007 effort reflected in Navigation, Electro Optic/Infrared (EO/IR), and Sensor Technologies activity. (NRL)
- Autonomous Systems: Initiate development of near optimal trajectory planners to enhance the capabilities of UAVs and other distributed autonomous systems. FY 2007 effort reflected in Navigation, Electro Optic/Infrared (EO/IR), and Sensor Technologies activity. (NRL)

FY 2007 Plans:

- Efforts no longer funded in this Activity.

	FY 2005	FY 2006	FY 2007
NAVIGATION, ELECTRO OPTIC/INFRARED (EO/IR), AND SENSOR TECHNOLOGIES	13,073	6,869	13,844

This activity describes Navy Science and Technology (S&T) investments in the areas of Electro Optic/Infrared devices, Global Positioning Station (GPS) and Fiber Optic Gyro (FOG) Navigation systems, and advanced sensors. The network centric and navigation technology effort is focused on improving the navigation accuracy of Naval

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

forces through improvements in FOGs, distributed timekeeping systems, and GPS improvements. This effort also includes NRL investment/performance in the technology areas of Electronics, Electronic Warfare, and Communications.

Changes in the funding profile between FY 2005 and FY 2007 are due to natural progression of program initiations and completions.

FY 2005 Accomplishments:

- Navigation Technologies: Continued Precision Time and Time Interface transfer demonstration, Deeply Coupled Global Positioning System/Inertial Navigation System (GPS/INS) with nonlinear filter algorithm development, Distributed Time Standards Technology, Rb Double Bubble Maser Atomic Clock, and static testing of Tightly Coupled GPS/INS/Loran projects. Initiated the following project: Fiber Optic Ring Gyroscope Development.
- Electro-Optic/Infrared (EO/IR) technologies: Continued Multispectral Infrared Focal Plane Array (IRFPA) assembly and testing, and fabrication of photonic Millimeter Wave (MMW) threat detection prototype receivers. Continued development of high-performance, low-cost EO/IR airborne surveillance sensors for unmanned aerial vehicles, and ultra-high performance EO/IR Imagers. Continued development of auto-target identification techniques for Laser Range-gated imagers.
- Electronics: Continued spectral emittance based target discrimination work, long wave IR (LWIR) “W”-structured type-II superlattice (WSL) development, GaSb substrate study, and high power laser Hollow Core (HC)-Photonic Band Gap (PBG) effort. Initiated study Yb doped ceramic YAG and Y2O3 for optical cooling efficiency, investigated high power 1030 nm lasers as a pump source. (NRL)
- Electronic Warfare: Completed Infrared Counter Measures (IRCM) effort by implementing preprocessing and track algorithms into imaging seeker surrogates. (NRL)
- Communications: Continued IR obscurant technology development defining high aspect ratio particle characterizations and synthesized rod-shaped nanoparticles. Provided demonstrations of covert laser communications using Multi-Quantum Well (MQW) retroreflectors to several operational units. Increased bandwidth of MQW retroreflector laser communications system with Cat's eye Backplane. (NRL)

FY 2006 Plans:

- Navigation Technologies: Continue Distributed Time Standards algorithm development, Rb Clock design and experiments, and Link 16 Time Transfer development and testing. Continue Tightly Coupled GPS/INS/LORAN effort and Fiber Optic Ring Gyroscope development. Complete Algorithm development for Distributed Time Scaling and

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

the Deeply Integrated GPS/INS width Nonlinear Filter project. Initiate the Magnetic Passive Reset for Inertial Navigation System (INS) and the development of Advanced GPS/INS (GIN) Systems for Strike Weapons.
- EO/IR: Continue development of low cost piezoelectric motion and jitter compensation for high resolution visible and infrared sensors. Millimeter Wave (MMW) and TeraHertz (THz) Imaging effort will complete development of MMW imagers and continue development of THz imaging through fog, clouds, clothing, and some walls. Continue Nano Sensors development of ultra low noise uncooled nanotechnology infrared sensors and nanoatomic sensor nonvolatile memories. Electronic Zoom effort will continue development of electronic liquid crystal based directional field of view and zoom imagers. Continue multi-sensor (visible, infrared, millimeter wavelength, terahertz and laser imagers) fusion for objection recognition.
- Electronics: Continue high power HC-PBG development and Yb doped ceramic YAG high power laser efforts. Complete target discrimination effort by conducting a real time demonstration of spectral emmitance based target/material target discrimination using Long Wave (LW) Quantum Well Infrared Photodetector (QWIP) sensor. Complete study of WSLs for multiband IR photodiodes by demonstrating high performance dual-band Long Wave (LW) & Very Long Wave Infrared (VLIR) photodiode operation. Complete study of pre-growth molecular hydrogen cleaning of GaSb substrates. (NRL)
- Electronic Warfare: Continue IR obscurant technology development fabricating and evaluating fieldable IR obscurants and particle dissemination methods. (NRL)
- Communications: Continue covert high bandwidth communications effort. Complete development of MQW retroreflector with Cat's Eye Backplane. Transition compact, light-weight MQW communications to operational forces. Initiate the development of small hyperspectral sensors and associated signal processing algorithms in a compact format that will fit in small UAVs and be capable of detecting small targets. (NRL)

FY 2007 Plans:

- Navigation Technologies: Continue Rb Clock development and testing, Fiber Optic Ring Gyroscope development, Magnetic Passive reset for INS, and Advanced GPS/INS systems for strike weapons. Initiate self-locked Intra-Cavity Alkali Vapor Laser (ICAL) opto-atomic clock project and Repeat spoofer detection and location project. Complete Network Centric Navigation (Link-16 Time Transfer), Distributed Time Standards, and Tightly Coupled GPS/INS/Loran efforts.
- EO/IR: Complete development of low cost piezoelectric motion and jitter compensation for high resolution visible and infrared sensors. Continue Millimeter Wave (MMW) and TeraHertz (THz) Imaging project. Complete development of ultra low noise uncooled nanotechnology infrared sensors and continue development nanoatomic sensor nonvolatile memories. Complete development of electronic liquid crystal based directional field of view and zoom imagers. Complete multi-sensor (visible, infrared, millimeter wavelength, terahertz and laser

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

imagers) fusion for objection recognition effort.
- Electronics: Complete demonstration of high laser power through IR transmitting HC-PBG fiber. Complete performance optimization and scaling law development for the Radiation Balanced Laser. (NRL)
- Electronic Warfare: Complete development of IR obscuration technologies for surface vessel protection to achieve order of magnitude improvement over current obscurants and develop dissemination system prototype. (NRL)
- Communications: Continue development of free space laser communications systems with the development of a hybrid infrared system with dramatically lower power requirements at the sensor/transmitter. Continue small hyperspectral sensor development. (NRL)
- Complete long-term demonstration of multiple sensor-equipped vehicles, covering autonomous sensing operation and multiple replenishment/relocation cycles under autonomous or semi-autonomous control. (NRL)
- Complete development of small autonomous mobile expendable EW vehicles that can replenish their energy supply. Select multi-mode locomotion method and energy harvesting technique and construct and demonstrate vehicles. (NRL)
- Continue development of MAV. (NRL)
- Automous Systems: Continue development of near optimal trajectory planners to enhance the capabilities of UAVs and other distributed autonmous systems. (NRL)

	FY 2005	FY 2006	FY 2007
DIRECTED ENERGY AND EM GUNS (FORMERLY ELECTRIC WEAPONS)	27,864	33,087	30,759

The goal of this activity is to develop Directed Energy (DE) and Electric Propulsion power weapons for Navy applications. One major component of the DE program is the Free Electron Laser (FEL) which if successful could be applicable for shipboard applications as a defense weapon against advanced cruise missiles and asymmetric threats. The other major component is the Electro Magnetic (EM) gun program that is focused on developing the technology to launch a long range projectile from Navy ships. This activity also includes NRL investment/performance in these research areas.

Increase in FY 2005 is due to the addition of $13M for EM Gun and an additional $3M invested in the Directed Energy effort. Increase in FY 2006 and decrease in FY 2007 is due to funding profile of EM Gun program.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

FY 2005 Accomplishments:

- DE: Continued with fabrication of high current, high brightness injectors including superconducting Radio Frequency (RF) cavity base design. Conducted experiments with alternative FEL amplifier configurations to compare performance to current oscillator configuration and to determine the best scale up path to a megawatt FEL. Initiated Solid State Laser (SSL) fiber phasing technology development. Initiated development of High Power Microwave (HPM) source technology. Initiated support to Joint Office of the Secretary of Defense (OSD) High Power SSL program.
- EM Gun: Initiated design of prototype, 1/2 scale 32 MegaJoule (MJ) EM gun system. Conducted risk reduction efforts relating to arcing and rail wear/gouging.
- Investigated tribologic aspects of sliding metal-to-metal high current contacts in the rails of EM railguns. (NRL)

FY 2006 Plans:

- DE: Continue 1 micron filamentation, halo limitation, and short Rayleigh range studies. Continue lethality testing and optical propagation studies. Current injector task will complete assembly and test the Advanced Energy Systems (AES) Cryounit. Continue testing of RF gun High Voltage Power Supply (HVPS) components which are required for the 100 kW high current injector. Install HVPS gun and commission HVPS. Begin gun performance tests and 750 MHz cryounit integration. FEL development effort will continue 750 MHz cryomodule design, complete facility upgrade for 100 kW FEL development, and begin cryomodule construction.
- EM gun: Develop inital technology for Full Scale Proof of Concept Demonstrator for testing of integrated launch package (ILP) in 2009. Conduct investigation of improved rail gun rail wear techniques. Conduct testing of capacitor based pulse forming network system to 32 megajoules (of 200 required) of stored power with prototypical rail gun system increasing in power level and projectile speed, while examining rail/bore life issues expected to be seen at larger scale.
- Continue to pursue superior designs of insulators to handle the thermal and mechanical shocks generated by the launch in EM railguns. (NRL)
- Initiate development of novel electric weapon architectures and designs that enhance performance and maintainability. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

FY 2007 Plans:

- DE: Complete gun performance tests. Complete 750 MHz Cryounit integration and low power characterization. FEL development task will complete cryomodule design. Continue cryomodule construction. Continue FEL development and investigation into the application of FEL technology to other areas including advanced materials, optics, bioscience, medical, manufacturing, weaponization, and solid state physics.
- EM Gun: Complete preliminary designs of 32MJ muzzle energy electromagnetic demonstration launchers and begin detailed design with industry partners in preparation for fabrication (FY08/09) and demonstration (FY10). Continue bore life risk reduction tests by scaling laboratory launcher muzzle energy from 8 to 16MJ to ensure bore life characteristics of the rails and insulators apply at the higher energies. Finalize projectile conceptual designs from two industry vendors and begin projectile preliminary design. Initiate conceptual design of rotating machine pulsed power. Continue Integrated Product Team (IPT) collaborations between industry, Navy and the Army Electromagnetic Launch program to ensure consistent, non-duplicative technology maturity activities.
- Continue investigation of surface treatments such as advanced coatings or "MAX-phase" materials to harden the rails in electromagnetic railguns. (NRL)
- Continue development of designs for viable novel electric weapon architectures that enhance performance and maintainability. (NRL)

	FY 2005	FY 2006	FY 2007
STRIKE AND LITTORAL COMBAT TECHNOLOGIES	3,717	1,630	12,465

The focus of this effort is on those technologies that will support Naval Precision Strike Operations and provide the Navy of the future the ability to quickly locate, target, and strike critical targets ashore. NRL investment/performance in this effort is included. Efforts in this PE transitioned from these PEs 0602131M, 0602235N, 0602236N, 0603114N, 0603236N and 0603640M.

The funding profile from FY 2006 to FY 2007 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Advanced Naval Fires Technology Spiral 1, Hostile Fire Detection and Response Spiral 1, Marine and UxV Tactical ISR, and Dynamic Target Engagement & Enhanced Sensor Capabilities.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

FY 2005 Accomplishments:

- Advanced Gun Barrel (AGB) & Seeker Technology: Continued development including gun fire testing of 45mm inserts used in coating technologies. Conducted mechanical and thermal analysis and tested composite material samples for the composite barrel design. Effort transitions to PE 0603114N in FY06.
- Initiated development and demonstration of image-while-scan (IWS) technologies needed to perform imaging and identification of targets of radars operating in non-spotlight mode. (NRL)
- Continued development of new queing receiver brassboard for high probability of intercept wide instantaneous bandwidth receiver. (NRL)
- Continued development of and construction of retrievable airborne W-Band decoys and conducted W-band Radar Cross Section (RCS) experiment with NRL passive decoy and WARLOC radar. (NRL)
- Initiated development of improved processing algorithms based on Joint Time Frequency Analysis (JTFA) for integration into existing Synthetic Aperture Radar (SAR) image formation processors to enhance the resolution and target characterization of SAR data. (NRL)

FY 2006 Plans:

- Hand Held Precision Targeting: Initiate/complete development of the rangefinder module including integration of an inertial measurement unit (IMU) and magnetometer. This will allow the forward observer to use a laser range finder for target designation in a magnetically hostile environment.
- Continue SAR algorithm development, IWS technology development, and wide bandwidth amplifier development. (NRL)
- Complete queing receiver brassboard for a high probability of intercept wide instantaneous bandwidth receiver and conduct a small-scale signal collection in a maritime environment field test. (NRL)
- Continue W-band decoy development. (NRL)
- Continue JFTA improved processing algorithm development. (NRL)
- Initiate development of software for a genetic algorithm selection process for use with identified analytic performance metrics for the optimization of communications jamming techniques. (NRL)

FY 2007 Plans:

- Marine and UxV Tactical ISR (MUTI): Initiate effort to develop improved radar that will provide real-time tactical targeting and improved sensor processing to provide improved access to available ISR products.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

Specific tasks include: signal intelligence visualization, automated pattern recognition, dynamic replanning/autonomous vehicle control, fully integrated advanced demonstrator engine, multi-vehicle cooperation/targeting and networking communications software. (formerly funded in PE's 0602131M and 0603114N)
- Dynamic Target Engagement & Enhanced Sensor Capability (DTEESC): Initiate effort to develop the capability to improve the processing of dynamic targets from 100 to 400 targets per day. It will also improve UAV performance in the areas of increased endurance and support for more autonomous operations. Specific tasks include the development of: decision support algorithms for dynamic target engagement, remote sensor fusion hardware for ground sensors, an ultra endurance UAV, and a Ground Moving Target Indicator (GMTI) sensor for use on UAVs. (formerly funded in PE's 0602235N, 0603640M, and 0603114N)
- Hostile Fire Detection and Response Spiral 1 (HFDR): Initiate effort to develop technologies for hostile fire detection and active response capabilities that will increase individual Marine and tactical level unit survivability and mobility. Specific efforts include: advanced ammo packaging, Electronic Warfare(EW) Integrated System for Small Platforms (EWISSP), and the GUNSLINGER hostile fire detection and counter fire system. (formerly funded in PE's 0602131M, 0602236N, and 0602235N)
- Advanced Naval Fires Technology Spiral 1 (ANFT): Initiate effort to reduce the time delay from target acquisition to engagement through improved information sharing interfaces, accurate mobile and lightweight fire control systems, and improved forward digital target acquisition and hand off. Specific tasks include: adaptive expeditionary maneuver warfare system, advanced gun barrel technology, advanced weapons material technology, improved fire control systems, advanced fires coordination technology, and advanced target acquisition. (formerly funded in PE's 0602236N and 0603236N)
- Complete W-band decoy development with a demonstration of active ECM techniques. (NRL)
- Complete the development of improved processing algorithms based on the JFTA by incorporating algorithmic tools into existing SAR system for testing. (NRL)
- Continue IWS technology development. (NRL)
- Continue genetic algorithm selection process for communication jamming.(NRL)

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ADVANCED HIGH-ENERGY THERMOBARIC WARHEAD DEVELOPMENT	963	0

This effort demonstrated an advanced high-energy thermobaric explosive composition that will provide enhanced internal blast pressures and moderate thermal effects in confined environments for the M72 LAW (Light Anti-tank Weapon) ASM. Primary efforts included fuze development and booster testing.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

	FY 2005	FY 2006
ADVANCED HYBRID STORED ENERGY DEVICES FOR AFFORDABLE AIR WEAPONRY	1,446	0

Effort supported Advanced Hybrid Stored Energy Devices for Affordable Air Weaponry.

	FY 2005	FY 2006
ADVANCED REACTIVE MATERIAL ENHANCED NANOCOMPOSITE WARHEADS (ARMENW)	2,506	0

This effort supported the manufacturing technology development and production scale up of high density nano material composites used in the construction of advanced warheads for air and surface weapons.

	FY 2005	FY 2006
ADVANCED SMART OPTICAL SENSOR PAYLOAD TECHNOLOGY FOR SURVEILLANCE	963	0

Effort developed Advanced Smart Optical Sensor Payload Technology for Surveillance.

	FY 2005	FY 2006
AIRCRAFT CARRIER SURVEILLANCE SYSTEM	2,700	3,500

FY 2005 - Effort developed Aircraft Carrier Surveillance System.

FY 2006 - This effort supports the Aircraft Carrier Surveillance System.

	FY 2005	FY 2006
AUTONOMOUS UNDERWATER VEHICLE DOCKING AND RECHARGING STATION	0	2,100

This effort supports autonomous underwater vehicle docking and recharging station research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

	FY 2005	FY 2006
COMBUSTION LIGHT GAS GUN	4,051	4,250

FY 2005 - This effort developed the technologies for a hyper-velocity weapon based on high-energy electric plasma ignition heating of injected light gas. Designed a 155mm CLGG system capable of demonstrating full scale, single shot performance. Demonstrated operational characteristics using cryogenic propellants.

FY 2006 - This effort supports combustion light gas gun research.

	FY 2005	FY 2006
DEVELOPMENT PROCESSES FOR FULL SCALE PRODUCTION OF SILICON CARBIDE WAFERS	0	1,700

This effort supports development processes for full scale production of silicon carbide wafers research.

	FY 2005	FY 2006
DEVICE INTEGRATION OF WIDE BAND GAP SEMICONDUCTORS AND MULTIFUNCTIONAL OXIDES	1,640	1,500

FY 2005 - This effort commissioned a deposition system for oxide component deposition and quantified growth parameter variables. Grew test structures for initial calibration and feedback for optimization of deposition parameters.

FY 2006 - This effort supports device integration of wide band gap semiconductors and multifunctional oxides research.

	FY 2005	FY 2006
DOD AGILE MANUFACTURING CENTER FOR CASTINGS TECHNOLOGY (AMCAST)	0	2,100

This effort supports the DOD Agile Manufacturing Center for Castings Technology (AMCAST).

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

	FY 2005	FY 2006
ELECTROMAGNETIC (EM) RAIL GUN TEST MUNITION	1,060	0

This effort developed Electromagnetic (EM) Rail Gun Test Munition.

	FY 2005	FY 2006
ELECTRONIC MOTION ACTUATION SYSTEMS	0	2,200

This effort supports electronic motion actuation systems.

	FY 2005	FY 2006
FIRELIDAR	1,640	0

This effort developed an eyesafe laser imaging system complementary to IR imagers. Effort developed innovative technologies to overcome the deficiencies of an infrared sensors used by firefighters. These sensors currently bloom and become useless in brightness of a hot fire. Approach used laser illumination and spectral filters to see through fire and smoke. Imagery will also be relayed via a wireless LAN to the command center.

	FY 2005	FY 2006
FREE ELECTRON LASER	0	3,500

This effort supports technologies to support the development of a high average power Free Electron Laser system that is applicable to shipboard self defense.

	FY 2005	FY 2006
HIGH ENERGY DENSITY CAPACITORS FOR MILITARY APPLICATIONS	0	1,500

This effort supports high energy density capacitors for military applications research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

	FY 2005	FY 2006
HIGH PERFORMANCE FREQUENCY MODULATED FIBER OPTIC LINK	0	1,200

This effort supports high performance frequency modulated fiber optic link research.

	FY 2005	FY 2006
HIGH POWER FEL DEVELOPMENT FOR NAVY APPLICATIONS	0	1,500

This effort supports high power FEL development for Navy applications research.

	FY 2005	FY 2006
HYPERSONIC WEAPONS ENABLING CAPABILITY	963	0

This effort extended the capabilities of the Integrated Hypersonic Aeromechanical Tool (IHAT) and developed a virtual weapon simulation that will support the extended analysis of high speed weapons.

	FY 2005	FY 2006
INTEGRATED BIOLOGICAL WARFARE TECHNOLOGY PLATFORM	3,375	0

This effort applied the integrated Biological and Chemical Warfare Defense (IBCWD) decision analysis technology software to survey vessels approaching aircraft carriers on the high seas. Transformed the IBCWD software framework into a system that provides situation awareness, real-time response planning, and integrated collaborative center for decision maker interaction.

	FY 2005	FY 2006
INTEGRATED PERSONNEL PROTECTION SYSTEM	1,156	0

Effort developed an Integrated Personnel Protection System consisting of a miniaturized wearable computing device, integrated sensors and a display system. System will be capable of providing alert reports and situational information to the command stations.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

	FY 2005	FY 2006
KILL ASSIST ADVERSE-WEATHER TARGETING SYSTEM (KAATS)	1,640	0

This developed technologies to support a system that will provide precision targeting and weapon delivery in adverse weather for time critical missions. Integrated sensor platform UAV. Demonstrated sensor on a UAV with relative targeting against a fixed target.

	FY 2005	FY 2006
MARINE MAMMAL RESEARCH PROGRAM	0	1,000

This effort supports the Marine Mammal Research Program.

	FY 2005	FY 2006
MDETEC	0	1,000

This effort supports MDETEC research.

	FY 2005	FY 2006
MILLIMETER/TERAHERTZ IMAGING ARRAYS	2,026	3,600

FY 2005 - This effort developed technology to realize simultaneous infrared (IR) and millimeter wave (MMW) imaging capabilities through a common aperture and to fuse IR and MMW imagery for all-weather and high resolution imaging.

FY 2006 - This effort supports millimeter/terahertz imaging arrays research.

	FY 2005	FY 2006
MOBILE ON-SCENE SENSOR AIRCRAFT C4I CENTER	963	0

This effort developed the technology for a mobile forward C4I deployed center that can receive imagery from an airborne sensor and executing command and control over that sensor.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

	FY 2005	FY 2006
MULTI-SENSOR HYPERSPECTRAL SYSTEM FOR DAY/NIGHT RECONNAISSANCE	0	2,600

This effort supports multi-sensor hyperspectral system for day/night reconnaissance research.

	FY 2005	FY 2006
NAVY SECURITY AUTOMATION AND FUTURE ELECTRO-ROBOTS	0	1,000

This effort supports Navy security automation and future electro-robots research.

	FY 2005	FY 2006
OBLIQUE ANGLE HYPERSPECTRAL IMAGE FUSION	0	1,650

This effort supports oblique angle hyperspectral image fusion research.

	FY 2005	FY 2006
RETROREFLECTING OPTICAL COMMUNICATIONS FOR SPECIAL OPERATIONS	1,928	1,000

FY 2005 - This effort increased retro reflector data rate to 10-50 Megabits per second. This effort developed a micro electronic mechanical system (MEMS) optical mirror, steered laser interrogator on a small tactical UAV and interrogate a 50 Mbps retro-reflector on an unattended ground sensor.

FY 2006 - This effort supports retroreflecting optical communications for special operations research.

	FY 2005	FY 2006
SILVER FOX UNMANNED AERIAL VEHICLE (UAV)	2,413	1,750

FY 2005 - This effort integrated the latest sensor and data link technologies into the Silver Fox UAV. The work expanded the operational use of Silver Fox into the maritime environment.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

FY 2006 - This effort supports the Silverfox UAV.

	FY 2005	FY 2006
SPECTRAL BEAM COMBINING FIBER LASERS	0	1,000

This effort supports spectral beam combining fiber lasers research.

	FY 2005	FY 2006
THERMAL MANAGEMENT SYSTEMS FOR HIGH DENSITY ELECTRONICS	5,787	5,600

FY 2005 - This effort evaluated and demonstrated advanced cooling techniques for military processing systems. The work used the advanced cooling techniques that were developed and refined the techniques to work within the space, weight, and durability requirements of mobile electronics.

FY 2006 - This effort supports thermal management systems for high density electronics research.

	FY 2005	FY 2006
ULTRA HD PROJECTION DISPLAY	0	1,500

This effort supports ultra HD projection display research.

	FY 2005	FY 2006
UNATTENDED IMAGING SENSOR NETWORK (UISN)	963	0

The Unattended Imaging Sensor Network (UISN) developed a low probability of intercept (LPOI) unattended imagery node network used by Special Operations Forces (SOF) for surveillance and force protection missions.

	FY 2005	FY 2006
WORK FLOW ENGINE FOR OFF-LINE IMAGERY	0	1,000

This effort supports work flow engine for off-line imagery research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0601152N (In-House Laboratory Independent Research)
PE 0601153N (Defense Research Sciences)
PE 0602123N (Force Protection Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602235N (Common Picture Applied Research)
PE 0603114N (Power Projection Advanced Technology)
PE 0603640M (USMC Advanced Technology Demonstration)
PE 0603790N (NATO Research and Development)

NON-NAVY RELATED RDT&E:
PE 0602303A (Missile Technology)
PE 0602618A (Ballistics Technology)
PE 0602624A (Weapons and Munitions Technology)
PE 0603004A (Weapons and Munitions Advanced Technology)
PE 0602702E (Tactical Technology)
PE 0603739E (Advanced Electronics Technologies)
PE 0603763E (Marine Technology)
PE 0602203F (Aerospace Propulsion)
PE 0602601F (Space Technology)
PE 0602602F (Conventional Munitions)
PE 0603216F (Aerospace Propulsion and Power Technology)

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
FORCE PROTECTION APPLIED RESEARCH	134,211	138,094	123,443	123,678	134,228	131,083	140,634

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. It supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. The goal is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability. This is accomplished by improvements in platform offensive performance, stealth, and self defense. This PE supports the Future Naval Capabilities (FNC) Program in the areas of Sea Shield, Sea Strike, and Cross Pillar Enablers.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	143,652	101,650	130,227
Congressional Action	0	37,900	0
Congressional Undistributed Reductions/Rescissions	-110	-1,534	0
Execution Adjustments	-9,028	0	0
FY 2005 SBIR	-2,303	0	0
GWOT Counter IED Efforts	2,000	0	0
Program Adjustments	0	78	-5,146
Program Realignment	0	0	-1,937
Rate Adjustments	0	0	299
FY 2007 President's Budget Submission	134,211	138,094	123,443

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
This PE supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. Each PE Activity has unique goals and metrics, some of which include classified quantitative measurements. Overall metric goals are focused on achieving sufficient improvement in component or system capability such that the 6.2 applied research projects meet the

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH

need of or produce a demand for inclusion in advanced technology that may lead to incorporation into acquisition programs or industry products available to acquisition programs.

Specific examples of metrics under this Program Element include:
- Reduce the weight of current structural protection systems by 30% maintaining current energy absorption capabilities by FY 2007.
- Provide improvements in electrical component and device technology as to allow a 50% reduction in motor propulsion and motor controllers weight and volume by FY 2009.
- Increase the hydrodynamic efficiency of current hull designs by 5% by FY 2010.
- Reduce electromagnetic vulnerability of ship hulls by 50% by FY 2011.
- Torpedo defense thresholds will be validated by modeling and simulation to satisfy the overall system performance specification of a Probability of Survival (PS) of the US Navy platform as specified in the draft Capabilities Development Document (CDD) for Surface Ship Torpedo Defense.
- Additional metrics are included within the Missile Defense Activity description.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
FORCE PROTECTION APPLIED RESEARCH	85,095	100,194	123,443	123,678	134,228	131,083	140,634

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. It supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. The goal is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability by virtue of improvements in platform offensive performance, stealth, and self defense. This effort supports the Future Naval Capabilities (FNC) in the areas of Sea Shield and Cross Pillar Enablers.

The funding profile from FY 2006 to FY 2007 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Fortified Position Security, Over-the-Horizon Missile Defense, Two-Torpedo Salvo Defense, Defense of Harbor and Near-Shore Naval Infrastructure Against Asymmetric Threats, Sea Based Missile Defense of Ships & Littoral Installations, Aircraft Integrated Self-Protection Suites, Hostile Fire Detection and Response Spirals 1 and 2, and Advanced Electronic Sensor Systems for Missile Defense.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
SURFACE SHIP & SUBMARINE HULL MECHANIC & ELECTRICAL (HM&E)	50,334	48,611	69,356

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

Efforts include: signature reduction, hull life assurance, hydromechanics, distributed control for automated survivability (includes damage control), and advanced electrical power systems. Signature reduction addresses electromagnetic, infrared, and acoustic signature tailoring, both topside and underwater. Hull life assurance addresses development of new structural system approaches for surface ships and submarines, including the management of weapons effects to control structural damage and the improvement of structural materials. Hydromechanics addresses hydrodynamic technologies, including the signature aspects of the hull-propulsor interface and maneuvering. Distributed intelligence for automated survivability addresses both the basic technology of automating damage control systems, as well as, distributed control of systems utilizing self-healing capability. Advanced electrical power systems efforts address electrical and auxiliary system and component technology to provide improvement in energy and power density, operating efficiency and recoverability from casualties.

Funding increase in FY 2007 is for PDM Power and Energy Technology.

FY 2005 Accomplishments:

- Continued advanced numerical acoustic codes (and gridding methods for those codes) for submarines.
- Continued feasibility study of Distributed Pump-Jet Propulsion (DPJP) system concept for submarines.
- Continued validation of computational tools for ducted propulsor design/analysis.
- Continued development of propeller sub-visual cavitation inception scaling law.
- Continued the validation of circulation control and advanced control surfaces with experiments.
- Continued validation of asymmetric hull forms with experimental data.
- Continued submarine propulsion jet cavitation analysis and experiments.
- Continued experimental database/computational tools development for extreme submarine maneuvers (e.g., crashback).
- Continued algorithm/finite element model validation for submarine advanced degaussing/deamping.
- Continued analytical and modeling investigation of cavitation, powering, and acoustic performance of submarine propellers.
- Continued Biofilms on Scaffolds and Characterize Spatial Distribution and Chemistries. (NRL)
- Continued efforts to synthesize new metal sulfides as catalysts for fuel cells and evaluate their electrochemical performance. (NRL)
- Continued additional comparison of DYSMAS analysis with German ship trial data.
- Continued demonstration of dynamic stability of an advanced intelligent, reconfigurable, solid-state-

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

based, zonal-electrical power system that reconfigures within 10 milliseconds.
- Continued designing software for the system manager for the Universal Control Architecture (UCA).
- Continued development of analytical models to further define submarine modular hull concepts.
- Continued development of Bacterial Mixture to Optimize Charge Generating Capacity. (NRL)
- Continued development of global surface wave measurement capability for ship models.
- Continued development of new Explosion Resistant Coatings against underwater explosion and ballistic threats in support of JEERCE ACTD.
- Continued development of reliability based design and structural analysis code development.
- Continued development of signature tools for design of distributed pump-jet propulsion system (DPJP) concept for submarines.
- Continued development of surface ship acoustic flow noise model (joint effort with Dutch Navy).
- Continued development of technologies for future Marine Corps Battlefield Power System.
- Continued development of thermal management technology for shipboard power distribution.
- Continued Dynamic Behavior of Composite Ship Structures (DYCOSS) (joint effort with Dutch Navy).
- Continued High Surface Area Conducting Electrodes for use as Biofilm Scaffolds. (NRL)
- Continued investigation of hybrid composite to steel joints for hybrid surface ship hulls, contributing to agreement with Japan.
- Continued investigation of potential applications of silicon-carbide in future high voltage and high power applications.
- Continued investigation of superconducting degaussing techniques for surface ships.
- Continued mmWave Signatures Analysis.
- Continued modeling of electric warship components and system electromagnetic signatures.
- Continued development of technologies to support dynamic reconfiguration of shipboard systems under conditions of stressing scenarios and/or system degradation.
- Continued development of modeling and simulation methods for robust design and virtual testing of integration of shipboard auxiliary systems including their control systems.
- Continued next generation IR scene model and next generation IR code.
- Continued preparation for shock testing of composite hull section in cooperation with Germany.
- Continued ship service fuel cell development.
- Continued development of advanced power electronics for Electromagnetic Aircraft Launch System (EMALS) and ship main propulsion systems.
- Continued technology development for alternate approaches to high voltage fast turn off switches. (NRL)
- Continued technology development for wafer bonded high voltage power switches. (NRL)
- Continued the next generation Infrared Electro-Optic Visual (IR/EO/VIS) model for surface ships by

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

development of mitigation strategy supporting low observable infrared platforms, development of supporting physics, and prototype measurement techniques.
- Continued to develop design tool for integrated antenna and composite topside.
- Continued to investigate improved maneuvering simulation capability for submarines.
- Continued validation of Reynolds Average Navier-Stokes (RANS) code for advanced waterjet propulsor performance predictions.
- Transitioned preliminary testing data of Explosion Resistant Coating (ERC) against underwater explosion and ballistic threats to FY05 Joint Enhanced Explosion Resistant Coatings Exploitation (JEERCE) Advanced Concept Technology Demonstration (ACTD).
- Completed study of flow noise over submarine control surfaces.
- Completed documenting the historical use of circulation control technology in the Navy.
- Completed 9MVA (megavolt asynchronous) Power Electric Building Block (PEBB) developmental demonstrations.
- Completed an intermediate-scale experiment to establish proof of the blast mitigation concept.
- Completed analysis of forward-scatter experiments (ship-sea interaction).
- Completed analysis of the interaction of water-mist with Class A fuel.
- Completed characterization of the 5MW High Temperature Superconducting Motor for Electric Ship Research and Development Consortium (ESRDC).
- Completed demonstration of tolerance of NRL-patented fuel cell catalysts to sulfur dioxide in air, showing a significant improvement over state of the art platinum catalysts. (NRL)
- Completed development of a cross-polarizer Silicon Carbide (SiC) characterization method and transitioned it to industry. (NRL)
- Completed development of high frequency ship measurement capability.
- Completed development of modeling and simulation tools for submarine coating concept.
- Completed evaluation of prediction methods which relate ship hydrodynamics and ship signatures.
- Completed Evaluation of the 44 MVA Power System Emulator which is based on the 9 MVA PEBB.
- Completed numerical model for electromagnetic scattering.
- Initiated and completed validation of asymmetric threat on hull forms with experimental data.
- Initiated AC propagation experiments.
- Initiated Advanced Capability Electric Systems (ACES) applied research for on-board vehicle power system with trade studies and system design (transition to advanced technology effort in PE 0603123N in FY 2006).
- Initiated aperstructure technology demonstration.
- Initiated biofilm growth studies on high surface area electrodes and tested electrodes in a miniature prototype microbial fuel cell. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

- Initiated development of a low-cost submarine distributed propulsor concept.
- Initiated development of flexible composite propeller concept.
- Initiated development of pulsed power technology, to include pulsed alternators and capacitors.
- Initiated circulation control analysis for three-dimensional flow effects.
- Initiated development of quiet control surface design tool based on control surface flow noise studies.
- Initiated development of structural analysis codes describing failure mechanisms of sandwich composites.
- Initiated development of test vessel and technology to evaluate performance and signature associated with electrically driven waterjets (AWJ-21) and Rim-drive motor (Advanced Hull-form Inshore Demonstrator - AHFID).
- Initiated flow noise evaluations of surface ships with Advanced Electric Ship Demonstrator (AESD).
- Initiated hull machinery noise measurements.
- Initiated IR and radar detectability prediction capability.
- Initiated IR validation experiment planning.
- Initiated land-based test site (Purdue, NSWCCD) that will evaluate Integrated Engineering Plant (IEP) conceptual architectures to provide improved survivability of auxiliary systems that support combat systems.
- Initiated multi-year program to directly convert thermal energy to electricity. Such a capability would allow elimination of the steam cycle on an electric warship.
- Initiated validation of acoustics performance prediction method for distributed pump-jet propulsion (DPJP) concepts.
- Initiated validation of powering prediction method for distributed pump-jet propulsion (DPJP) concepts.
- Initiated work to assess cavitation performance of loop-bladed propulsor concept.
- Initiated development of a low-cost submarine distributed propulsor concept (RED-I).

FY 2006 Plans:

- Continue all efforts of FY 2005, except those noted as completed above.
- Continue ERC effort in core S&T and ACTD support. These efforts will provide US input to trilateral agreement with UK and Australia.
- Complete shock testing of composite hull section in cooperation with Germany.
- Complete development of advanced power electronics for Electromagnetic Aircraft Launch System (EMALS) and ship main propulsion systems.
- Complete development of flexible composite propeller concept.
- Complete development of propeller sub-visual cavitation inception scaling law.
- Complete the validation of circulation control and advanced control surfaces with experiments.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

- Complete submarine propulsion jet cavitation analysis and experiments.
- Complete development of a low-cost submarine distributed propulsor concept (RED-I).
- Complete validation of powering prediction method for distributed pump-jet propulsion (DPJP) concepts.
- Complete investigation of distributed pump-jet propulsion acoustic performance.
- Complete and deliver next generation IR scene model and next generation IR code.
- Complete comparison of DYSMAS analysis with German ship trial data.
- Complete biofilm growth studies on high surface area electrodes and characterization of miniature prototype microbial fuel cell. (NRL)
- Initiate prediction of constrained (heave and roll) capsize motions using advanced codes.

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as completed above.
- Transfer development of technologies for future Marine Corps Battlefield Power System to PE 0602236N in FY 2007.
- Complete evaluation of an Integrated Engineering Plant (IEP) concept to provide improved survivability.
- Complete Dynamic Behavior of Composite Ship Structures (DYCOSS) (joint effort with Dutch Navy).
- Complete modeling of electric warship components and system electromagnetic signatures.
- Complete ACTD support for ERC application to surface ships.
- Complete development of global surface wave measurement capability for ship models.
- Complete validation of computational tools for ducted propulsor design/analysis.
- Complete experimental database/computational tools development for extreme submarine maneuvers (e.g., crashback).
- Continue investigations of propulsor cavitation including mitigation concepts (passive and active)
- Continue composite and composite-metal hull performance characterization and testing including structural loading, thermal stress and signatures.
- Continue development and demonstration of distributed power generation and rapid power transfer within the context of zonal electric power systems and advanced electric architectures.
- Initiate large-scale tests on AESD to develop signature prediction and design tools for surface ship incorporating a variety of propulsion technologies including external podded propulsion.
- Initiate testing of 10X smaller microbial fuel cell and test membraneless designs in simulated environmental (marine, etc.) conditions. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

	FY 2005	FY 2006	FY 2007
ADVANCED ENERGETICS	9,376	14,745	15,837

Advanced Energetics efforts address technology development to provide substantial improvements in energetic material systems and subsystems, primarily in terms of performance, but also addressing safety, reliability, and affordability concerns. Goals include: advanced energetic materials for warheads, propellants, and reactive material based subsystems for both defensive and offensive applications. Efforts include: development of new fuels, oxidizers, explosive ingredients and formulations; and reliable simulation tools and diagnostics to develop and design superior-performance, and/or reduced-vulnerability systems tailored to specific warfighter missions.

FY 2005 Accomplishments:

- Initiated PDM II Advanced Energetics research in technology development for the next generation reactive material warhead concepts (formulations, material properties, target interaction, lethality models, and experiments) for highly reactive materials, high density reactive materials and novel reactive structural materials. Explosive testing occurred in fourth quarter of FY.
- Initiated PDM II Advanced Energetics research in development and evaluation of advanced explosive/propellant/reactive ingredients and formulations for next generation higher performing systems. Explosive testing occurred in fourth quarter of FY.
- Initiated PDM II Advanced Energetics research in development of advanced directed hydro-reactive material warhead concepts to enhance performance of undersea warheads. Explosive testing occurred in fourth quarter of FY.
- Initiated proof of concept efforts to develop insensitive explosives, propellants, and munitions without compromising performance. This work involves development of high quality, small particle energetic ingredients, novel processing techniques, and advanced energy conversion concepts; and involves both theoretical and experimental efforts.

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Initiate PDM II Advanced Energetics research in advanced multiphase blast concepts employing dense

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

metalized explosives to enhance performance of air and underwater blast warheads.
• Initiate PDM II Advanced Energetics research in development and diagnostics of novel energy conversion concepts to enhance performance, more efficiently exploit available energy, and more effectively couple energy to target for air, surface, and underwater warhead application.

FY 2007 Plans:

• Continue all efforts of FY 2006.

	FY 2005	FY 2006	FY 2007
FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS	9,789	17,828	12,438

Fleet Force Protection and Defense against Undersea Threats efforts include applied research for complementary sensor and processing technologies for platform protection and shipboard technologies to increase the survivability of surface ship and submarine platforms against torpedo threats and to develop the capability to interdict underwater asymmetric threats to ships and infrastructure in harbors. Current small platforms (both surface and airborne) have little to no situational awareness (SA) or self-protection against air, surface, and asymmetric threats. (Asymmetric threat efforts are co-funded by PE 0602131M.) A goal of this activity is to provide these platforms with effective self-protection. The technology areas specific to platform protection will develop individual, multispectral (Electro-Optic (EO), Infrared (IR), Radio Frequency (RF), electromagnetic (EM), visual, and acoustic), or chemical sensors/biosensors and associated processing. To defend platforms from current and advanced threats in at-sea littoral environments and in port, these technologies must improve multispectral detection and distribution of specific threat information.

Another goal of this effort is to develop a torpedo defense capability to fill Sea Shield Warfighting Capability Gap/Enabling Capability: Platform Defense against Undersea Threats, including Two Torpedo Salvo Defense. This provides a capability to prevent any of the torpedoes, in up to two-torpedo salvos fired at high value units, from hitting those units. Specific technology includes two efforts. The first is Next Generation Countermeasure (NGCM), a mobile adaptive acoustic countermeasure with acoustic communication links among countermeasures. The second is Anti-Torpedo Torpedo (ATT)/Tripwire Demonstration, of an ATT to engage the detected threat torpedoes.

This activity supports the Fleet and Force Protection Future Naval Capabilities (FNC). This effort includes

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

support to Sea Shield and Sea Strike Pillars and FNC Enabling Capabilities for Aircraft Integrated Self-protection Suite, Fortified Position Security, Advanced Electronic Sensor Systems for Missile Defense, and Hostile Fire Detection and Response Spirals 1 and 2. Budget Activity 2 sensor efforts are co-funded by PEs 0602235N and 0602271N.

An increase in funding in FY 2006 is due to new initiatives in NRL efforts, biomimetic technologies and Shipboard EO/IR Closed Loop Self Protection. Funding decreases in FY 2007 are due to a decrease in NRL activities, transferring the completion of the Shipboard EO/IR Closed Loop Self-Protection effort to PE 0602271N, and the transition of the Asymmetric Threat Weapon Program to PE 0602131M.

FY 2005 Accomplishments:

Sensors & Associated Processing –
• Continued the Shipboard EO/IR Closed Loop Self-Protection System effort by initial laboratory testing of the Mid-wave Infrared and Visible Laser System (MIRVLS) generating 15W in the 3-5um region.
• Continued the End User Terminal (EUT) effort by developing a prototype 2-way amplifier for the Secure Net (SECNET) 11 card that will increase by a factor of 9 the secure transmit/receive range between Dismounted-Digital Automated Computing Terminals (D-DACT) in an urban environment.
• Continued work on anti-tampering antenna isolation panels for NULKA decoys: fabricate hydrogen-bonded polymers and test for sensitivity to water degradation. Test isolation performance of new microwave absorbing composites. (NRL)
• Continued development of compact sensor systems in support of responsive Intelligence, Surveillance, and Reconnaissance (ISR). (NRL)
• Continued efforts on Antibodies for biowarfare agents to be synthetically modified with enzymes and studied via surface plasmon resonance to gain a better understanding of the impact tagging these recognition sites have on molecular recognition (kinetics and selectivity) for sensor applications. (NRL)
• Transferred development of a small aperture biomimetic bidirectional acoustic sensor to PE 0602236N and quantum dot reagents for real time chemical sensing to PE 0602435N in FY 2005. Quantum dot reagents for real time chemical sensing will move back to PE 0602123N in FY 2006.
• Completed the Applied Research Phase (6.2) of the EO/IR Laser Jammer for Tactical Aircraft (TACAIR) effort by performing baseline laboratory testing of surface-to-air missile (SAM) jam codes for all Tier 1 and 2 threat missiles. Effort continues under PE 0603123N.
• Completed the Applied Research Phase (6.2) of the Integrated Defensive Electronic Countermeasures Pre-Planned Product Improvement (IDECM P3I) effort by fabricating flexible .009 inch diameter conductors capable

of sustained operation at 5 kilovolts and >1750 degrees Fahrenheit. Effort continues under PE 0603123N.
• Completed development of a variable geometry mirror for the aircraft in conjunction with the ground based laser optics. (NRL)
• Completed the field tests to assess system performance and quantify influences on detection range with respect to signal detection and jamming of threats to low altitude platforms. (NRL)
• Completed the integration of all functions (detection, identification, and jamming) into a field testable Low Altitude Threat Detection and Jamming prototype and perform final concept test. (NRL)
• Completed development of user interface for low-cost compact adaptive optics system. (NRL)
• Initiated the design and development of integrated laser ground based, aircraft protection design to protect large aircraft from Infrared Surface to Air Missiles (SAMs) upon ingress and egress to an airport. (NRL)
• Initiated development of solid projectile coilgun design, consumable casing material and improved railgun efficiency and developed method of reducing muzzle flash and surface wear of the rails. (NRL)
• Initiated design and fabrication of microfluidic nucleic acid extraction and enrichment methods and obtained funding for technology transfer. (NRL)
• Initiated design and development of large (1.5m dia.) telescopes with associated adaptive optics for the Naval Prototype Optical Interferometer (NPOI). (NRL)

Underwater Platform Self-Defense -
• Completed development of NGCM test-bed power amplifier design for single crystal transducer. Transition to PMS415 PE 0101226N.
• Continued developing the mobile NGCM interface between guidance and control and signal generation electronics.
• Continued merging the Smart Adaptive Countermeasure (SACM) Smart Adaptive Processor and a generic signal generator board into a single module suitable for both Acoustic Device, Countermeasure (ADC) MK2 and NGCM.
• Initiated analysis of capability to enable limited acoustic communications among NGCM units.
• Initiated incorporation of ATT warhead acoustic model into TRM.

FY 2006 Plans:

Sensors & Associated Processing -
• Continue all efforts of FY 2005, less those noted as completed above.
• Continue development of reagentless sensors for weapons of mass destruction/explosives, including

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

luminescent quantum dot-based biosensors and engineered protein based sensors for detection of toxins (e.g., ricin, domoic acid) and explosives (e.g., TNT, RDX). (transferred from PE 0602435N in FY 2006)
• Complete the EUT effort by developing low cost, lightweight gunfire detection architecture with a production goal of less than $10,000 and weight of less than four pounds.
• Complete development of anti-tampering antenna isolation panels for NULKA decoys: demonstrate isolation performance and water degradability of microwave absorptive composite. (NRL)
• Initiate the Integrated EO/IR Self-protection Suite for Rotary Wing Aircraft effort by performing a platform integration analysis and design review.
• Initiate testing of the Mid-wave Infrared (MWIR) gunfire detection system with the D-DACT network for EUT.
• Initiate investigation of improved jam codes and closed-loop countermeasure techniques to integrate with the Shipboard Integrated Electro-Optic Defense Systems (SHIELDS) hardware for Shipboard EO/IR Closed Loop Self-protection.
• Initiate data collection for a database of chemical signatures from actual naval assets (land and water-based).
• Initiate efforts in nanoscale biosensor/bioprocessing components for platform protection.
• Initiate efforts in biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms.
• Initiate the development of low-cost, lightweight radar absorbing material (RAM) based on metallized cellulose in the form of fibers, fabric and paper. (NRL)
• Initiate design and testing of on-chip nucleic acid amplification and transfer technology. (NRL)
• Initiate studies to develop catalytic activity profile of bioactive coatings against chemical agents. Design and initiate fabrication of coatings to degrade both, chemical and biological agents. (NRL)
• Initiate development of a portable detection system for defense against small arms fire and rocket propelled grenades (RPG) using Field Programmable Gate Arrays (FPGAs), infrared focal plane arrays (IRFPA), and filtering algorithms. (NRL)

Underwater Platform Self-Defense –
• Continue all efforts of FY 2005.
• Complete merging the Smart Adaptive Countermeasure (SACM) Smart Adaptive Processor and a generic signal generator board into a single module suitable for both Acoustic Device, Countermeasure (ADC) MK2 and NGCM.

FY 2007 Plans:

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

- Continue all efforts of FY 2006, less those noted as complete above.
- Continue biocentric sensor for detection efforts including panoramic periscope and temporal pattern recognition for explosive noise location.
- Continue advanced concept development to integrate object recognition and tracking algorithms, machine vision, multiple networked video streams into different classes of EO/IR sensors within the Intelligent Video Surveillance FNC product (transferred from PE 0602131M).
- First demonstration of high resolution imaging of faint sources using the combined adaptive optics and optical interferometry at NPOI. (NRL)
- Transfer completion of the Shipboard EO/IR Closed Loop Self-Protection effort to PE 0602271N. Activities consist of developing additional jam codes and tracking algorithms and demonstrating their effectiveness during final at-sea testing of the Shipboard Integrated Electro-optic Defense System (SHIELDS) hardware including the at-sea turret with a field of regard of +/- 20 degrees in elevation and 360 degrees in azimuth.
- Complete development of quantum dot reagents for real time chemical sensing.
- Complete development of reagentless sensors for weapons of mass destruction/explosives, including luminescent quantum dot-based biosensors and engineered protein based sensors for detection of toxins (e.g., ricin, domoic acid) and explosives (e.g., TNT, RDX).
- Complete synthesis and acquisition of all the components needed for the fabrication of durable multifunctional coatings. (NRL)
- Initiate integration of DNA and antibody array analysis and demonstrate capability for rapid screening and pathogen species confirmation. (NRL)
- Initiate design and fabrication of self-reporting coatings for system failure detection. (NRL)

Underwater Platform Self-Defense –
- Continue all efforts of FY 2006, less those noted as complete above.
- Continue advanced concept development to integrate object recognition and tracking algorithms, machine vision, multiple networked video streams into different classes of EO/IR sensors within the Underwater Threat Neutralization FNC product (transferred from PE 0602131M).
- Continue advanced concept development of a scalable low frequency continuous wave acoustic weapon for use against underwater asymmetric threats (transferred from PE 0602131M).
- Complete processing algorithms for communications among NGCM units.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

	FY 2005	FY 2006	FY 2007
AIRCRAFT TECHNOLOGY	8,695	12,865	14,296

The Aircraft Technology activity develops high impact, scaleable naval air vehicle technologies, such as structures and flight controls for future and legacy air vehicles, integrated avionics, advanced electrical power systems, and aerodynamics, which significantly increase the naval warfighter's capabilities, effectiveness, readiness, and safety, while reducing life cycle cost. This activity directly supports the naval aviation vision, providing a robust and credible forward presence through flexible response and dominant power projection from the sea.

Increase in funding in FY 2006 is due to the addition of new projects in Ship-To-Objective Maneuver (STOM) and Heavy Lift System Concept efforts.

FY 2005 Accomplishments:

- Continued development of survivability/reduced observables technology (classified).
- Continued Computational Fluid Dynamics (CFD) modeling of ship airwake flows to provide higher fidelity.
- Completed design for demonstration of an all-composite replacement for dynamically loaded control surfaces for tactical aircraft.
- Completed Persistent Intelligence, Surveillance, and Reconnaissance (ISR) Unmanned Air Vehicle (UAV) technologies effort.
- Completed Joint Transformational Strike (JTS) technology addressing Automatic Target Recognition (ATR) and Combat Identification (CID).
- Initiated development of a new class of practical CFD-based engineering analysis and design tools to facilitate design of advanced high performance rotors.

FY 2006 Plans:

- Continue all efforts of FY 2005, less those noted as completed above.
- Complete CFD modeling of ship airwake flows to provide higher fidelity.
- Initiate demonstration of system integration of a shaped memory alloy into a Reconfigurable Rotor Blade system for improved range and lifting capacity in a tilt rotor aircraft.
- Initiate development of STOM Heavy Lift System Concept.
- Initiate development of flight control, intelligent autonomy, command & control, and multi-vehicle

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

cooperation technologies for unmanned air vehicles.
• Initiate development of a CFD based integration system to maximize operational capability of autonomous aircraft by choosing optional flight pattern for any environmental condition.
• Develop a new class of practical CFD-based engineering analysis and design tools for advanced high performance rotors.
• Initiate design concepts for an experimental vertical lift utility UAV.

FY 2007 Plans:

• Continue all efforts of FY 2006, less those noted as completed above.
• Initiate development effort to control flow and thermal dynamics in particle coating process and densification dynamics of large windows. (NRL)
• Refine/Evaluate/Validate CFD-based engineering analysis and design tools for advanced high performance rotors.
• Complete design and initiate technology development of an experimental vertical lift UAV.

	FY 2005	FY 2006	FY 2007
MISSILE DEFENSE (MD)	6,901	6,145	11,516

This activity describes Missile Defense S&T projects of the Sea Shield Future Naval Capability (FNC):
• Distributed Weapons Coordination (DWC) open architecture combat system algorithms for automated battle management aids (ABMA), including common threat evaluation (CTE) and preferred shot recommendation (PSR) functions that will enable fleet units to defend against air and missile attacks with increased effectiveness and efficiency. Metrics for DWC include (a) increased effectiveness of combat resources through a theater-wide threat evaluation process; (b) increased efficiency of weapons resources through weapon assignment and preferred shot recommendations considering Theater Ballistic Missile Defense (TBMD) and Area/Ship Defense capability operating simultaneously; and (c) reduced “free riders” (threats not fired at) due to ineffective use of resources (unengaged targets) by 50% (threshold) 80% (objective).
• Littoral Affordability (classified program). Metrics for this project are classified.
• Advanced Area Defense Interceptor (AADI) S&T planning effort for Navy - Marine Corps Air Directed Surface to Air Missile (ADSAM) live firing demonstration at White Sands Missile Range in FY 2008. The metric for AADI is execution of an ADSAM demonstration by the Navy and Marine Corps that establishes the basis for further development of an operational Naval Integrated Fire Control/Counter-Air (NIFC-CA) capability.
• Distributed Sensor Coordination (DSC) algorithms for airborne sensor management in ADSAM and multi-

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

threat air defense engagements. The metric for DSC is effective coordination of airborne sensor resources to support NIFC-CA capability, evaluated using laboratory Monte Carlo simulations within simulated stressing air defense environments.

- Naval Interceptor Improvements (NII) technology upgrades for STANDARD Missile 6 (SM-6) Block II future fleet air defense missile. The metrics for this new project will be defined in a transition agreement to be signed with the Navy acquisition customer upon project initiation in 2007 for an enhanced performance envelope for engaging advanced theater missiles in terminal phase while meeting or exceeding required performance against modern air threats.

Funding increase in FY 2007 is caused by addition of new NII project and introduction of NRL effort.

FY 2005 Accomplishments:

- Continued development of DWC and DSC algorithms for use in air and missile defense ABMA.
- Continued Littoral Affordability effort (classified program).
- Initiated and completed AADI experimental planning for the Navy ADSAM demonstration taking place under PE 0603123N in FY 2008.

FY 2006 Plans:

- Continue efforts of FY 2005.
- Complete Littoral Affordability effort (classified program).

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as complete above.
- Perform additional AADI S&T planning and coordination for the FY 2008 Navy ADSAM live-fire demonstration taking place under PE 0603123N.
- Complete development and documentation of DWC and DSC algorithms.
- Initiate NII project.
- Initiate program to investigate effects of charged particle layers on UHF to S-Band radars used to track space vehicles (NRL).

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ADPICAS	1,446	0

Initiated development of intelligent composite active structures and systems to provide precision position control and vibration suppression for military and space structures to enhance their structural performance and reduce their fuel consumption. Applications include fighter jets, helicopters, smart rockets, satellites, and space stations.

	FY 2005	FY 2006
ADVANCED FUSION PROCESSOR	0	2,600

This effort supports advanced fusion processor research.

	FY 2005	FY 2006
BATTERY CHARGING TECHNOLOGY	2,037	0

Continued research efforts funded in FY 2003 and FY 2004. Initiated development and validation of a charging algorithm for lithium-ion batteries. Initiated development of a DC-DC converter hardware design and engineering model.

	FY 2005	FY 2006
BLAST RESISTANT ANECHOIC SPRAYABLE ELASTOMERIC COATINGS FOR NAVY SHIPS	966	0

Initiated development, testing, and evaluation of a new coating system that can be applied to metal ship bulkheads and armored vehicles providing blast protection to the occupants. The end of the first year of development will result in one or more fire retardant coating systems that can be applied to metal structures and provide blast protection.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

	FY 2005	FY 2006
CENTER FOR CRITICAL INFRASTUCTURE PROTECTION	6,558	0

Initiated development of innovative technology solutions for use in the protection of critical infrastructure. Technologies developed will increase protection for ports and the merchant shipping system, maintaining port operations, and the surrounding infrastructure.

	FY 2005	FY 2006
COMPOSITE REPAIR OF METAL STRUCTURES	972	0

Initiated development of low cost, sonic resistant composite repairs for metal airframe structures. This new concept for the repair of the Navy’s aging fleet of both fixed wing and rotary wing aircraft offers the promise to extend the airframe life at a significantly lower cost and with greater reliability and safety than methods currently in use.

	FY 2005	FY 2006
COMPOSITES DEVELOPMENT FOR NAVY LOW RISE CONSTRUCTION	1,452	0

Initiated development and demonstration of prototype wood plastic composite (WPC) structural components for military housing. These structural components provide the following advantages relative to conventional wood products; (1) resist moisture penetration into the building structure, (2) resist high lateral loads from seismic and wind events, and (3) facilitate proper construction techniques.

	FY 2005	FY 2006
CORROSION MODELING SOFTWARE PROJECT - NAVAIR	4,088	0

Continued development and validation testing of workable corrosion maintenance guidelines and criteria for high strength steel components. Airframe criteria calling for the repair and/or replacement of all corroded parts in the Fleet are very difficult to implement both with respect to time and resources. The results of this effort enable maintenance teams to delineate between various aircraft corrosion states, with potential safety impacts and identification of corrosion that is cosmetic.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

	FY 2005	FY 2006
FACIAL RECOGNITION TECHNOLOGY	0	1,400

This effort supports facial recognition technology research.

	FY 2005	FY 2006
HIGH EFFICIENCY QUIET ELECTRIC DRIVE	966	1,500

FY 2005 - Initiated modification of the single-phase model to a three-phase model, test and evaluate.

FY 2006 - This effort supports high efficiency quiet electric drive research.

	FY 2005	FY 2006
HIGH FREQUENCY ACOUSTIC SIGNAL PROCESSOR SYSTEM	0	3,000

This effort supports high frequency acoustic signal processor system research.

	FY 2005	FY 2006
HYPERSPECTRAL DATA FUSION	3,278	0

Initiated demonstration of a hyperspectral/imager for surveillance and tracking in the airborne realtime processing on the NRL P-3 test aircraft.

	FY 2005	FY 2006
INTEGRATED FUEL PROCESSOR–FUEL CELL SYSTEM	1,933	0

Completed for demonstration a prototype integrated fuel processor/fuel cell system to operate on JP-5 fuel. If successful, the system may provide payoffs of increased efficiency and lower emissions of auxiliary power units used onboard aircraft and ocean-going vessels.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

	FY 2005	FY 2006
LIGHTWEIGHT SHIP STRUCTURES (LSS)	963	500

FY 2005 - Initiated research to explore, develop and optimize alloys based on Al-Zn-Mg-Sc-Zr. Efforts include alloy fabrication, microstructural and mechanical characterization, stress corrosion cracking studies, and development of a cost-benefit analysis, demonstrating the feasibility of implementing the alloy and providing the foundation for subsequent certification.

FY 2006 - This effort supports Lightweight Ship Structures.

	FY 2005	FY 2006
LITHIUM ION BATTERY FOR MULTIPLE NAVY AIRCRAFT (J-UCAS & T-45 TRAINER)	0	1,500

This effort supports lithium ion battery for multiple Navy aircraft (J-UCAS & T-45 Trainer) research.

	FY 2005	FY 2006
LOW-COST RAPID PROTOTYPE/PRODUCTION TECHNOLOGY FOR POLYMERIC AIRCRAFT COMPONENTS INITIATIVE	2,225	1,000

FY 2005 - Continued, from FY04, the development and qualification of a rapid prototyping and production technology based on Selective Laser Sintering (SLS) which will be used for the design, development, and qualification of advanced polymeric aircraft components. Focused on material and process optimization with emphasis on meeting aerospace application requirements.

FY 2006 - This effort supports the low-cost rapid prototype/production technology for polymeric aircraft components intiative.

	FY 2005	FY 2006
MAGNETIC REFRIGERATION TECHNOLOGY FOR NAVAL APPLICATIONS	0	1,900

This effort supports magnetic refrigeration technology for naval applications research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

	FY 2005	FY 2006
MINIATURE AUTONOMOUS VEHICLES (MAVS)	1,737	0

Continued in-water demonstrations of distributed communications and control architecture. Expanded multi-vehicle fleet to include underwater crawlers.

	FY 2005	FY 2006
MK V PATROL BOAT REPLACEMENT CRAFT PROTOTYPE	1,448	2,500

FY 2005 - Initiated construction of the new composite MKV.I prototype craft.

FY 2006 - This effort supports the MKV patrol boat replacement craft prototype.

	FY 2005	FY 2006
NANO-MAGNETIC MATERIALS FOR FUTURE MILITARY PROPULSION AND ENERGY SYSTEMS	0	1,400

This effort supports nano-magnetic materials for future military propulsion and energy systems research.

	FY 2005	FY 2006
NAVAIR CORROSION MODELING SOFTWARE PROJECT	0	2,100

Develope workable corrosion maintenance guidelines and criteria for high strength steel components, in particular arrestment gear of carrier aircraft. Present airframe criteria calling for the repair and/or replacement of all corroded parts in the Fleet are very difficult to implement both with respect to time and resources. The results of this effort will enable maintenance teams to delineate between various aircraft corrosion states, with potential safety impacts and identification of corrosion that is cosmetic.

	FY 2005	FY 2006
PEM FUEL CELL FOR VEHICLE SENSORS	0	1,000

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

This effort supports PEM fuel cell for vehicle sensors research.

	FY 2005	FY 2006
PMRF FORCE PROTECTION LAB	7,714	3,400

FY 2005 - Initiated development of force protection and security technologies by integrating, evaluating and demonstrating enabling technologies, tools, and processes. Approaches include integration of advanced sensor systems, novel sensor and data fusion processes, behavior modeling and analysis, and data mining and knowledge extraction techniques.

FY 2006 - This effort supports the PMRF Force Protection Lab.

	FY 2005	FY 2006
POLYMERIC AIRCRAFT COMPONENTS	0	1,000

This effort support polymeric aircraft components research.

	FY 2005	FY 2006
PROJECT ENDEAVOR	1,641	0

Completed production of a software system that integrates the design process for advanced marine vehicles with mission and environmental (wind, wave, etc.) requirements, will begin to produce some stand-alone modules dealing with mission planning, wave forecasting and hindcasting as well as completing the integration process. The major focus was technology transfer of system components.

	FY 2005	FY 2006
SECURE INFRASTRUCTURE TECHNOLOGY LABORATORY	0	6,800

This effort supports the Secure Infrastructure Technology Laboratory.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

	FY 2005	FY 2006
SMALL WATERCRAFT PROPULSION DEMONSTRATOR	1,447	1,500

FY 2005 - Initiated development of an advanced internal combustion engine and associated electrical generator.

FY 2006 - This effort supports small watercraft propulsion demonstrator research.

	FY 2005	FY 2006
STRUCTURAL RELIABILITY OF FRP COMPOSITE IN SHIP ASSEMBLIES	968	0

Completed analysis of mechanical property variability for composite laminates and the associated effect on structural reliability as it relates to design guidelines and analysis methods.

	FY 2005	FY 2006
THEATER SUPPORT VESSEL HULL MATERIAL DEVELOPMENT	1,928	0

Initiated the design and development of technologies including an alternative hull and air cushion for advanced littoral combat ships. These technologies allow improved delivery of firepower and information, as well as, increased hydrodynamic, aerodynamic, stealth, and survivability traits.

	FY 2005	FY 2006
THIN FILM BATTERY	1,941	1,400

FY 2005 - Initiated development and optimization of chemical vapor deposition and plasma thin film deposition techniques for thermal, lithium, and lithium ion battery materials and cells. The goal is to prove the feasibility of manufacturing these types of batteries, which will provide improved energy and power densities, safety and reliability over current technologies.

FY 2006 - This effort supports thin film battery research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

	FY 2005	FY 2006
UNDERSEA PERIMETER SECURITY TECHNOLOGY	0	1,200

This effort supports the undersea perimeter security technology research.

	FY 2005	FY 2006
UNMANNED SEA SURFACE VEHICLES FOR MARITIME MISSIONS	3,408	2,200

FY 2005 - Completed and delivered two prototype vehicles. Initiated operational testing to determine at-sea performance. Completed development of techniques for deploying and retrieving vehicles from host platform. Incorporated advanced power and autonomy technologies.

FY 2006 - This effort supports research of unmanned sea surface vehicles for maritime missions.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0601153N (Defense Research Sciences)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602235N (Common Picture Applied Research)
PE 0602271N (RF Systems Applied Research)
PE 0603123N (Force Protection Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603513N (Shipboard System Component Development)
PE 0603553N (Surface ASW)
PE 0603561N (Advanced Submarine System Development)
PE 0603573N (Advanced Surface Machinery Systems)
PE 0603609N (Conventional Munitions)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

PE 0604307N (Surface Combatant Combat System Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0604558N (New Design SSN)
PE 0604561N (SSN-21 Developments)

NON NAVY RELATED RDT&E:
PE 0602270A (Electronic Warfare Technology)
PE 0602204F (Aerospace Sensors)

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M
PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
MARINE CORPS LANDING FORCE TECHNOLOGY	33,940	38,016	37,741	39,414	40,245	41,287	42,229

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Marine Corps is tasked to develop, in conjunction with the Navy, Army, and Air Force, those phases of amphibious operations that pertain to tactics, techniques, and equipment used by the landing force. This Program Element (PE) is organized into five amphibious expeditionary warfighting capability areas. These are: Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR); Maneuver; Logistics; Human Performance, Training and Education; and, Firepower. The primary objective of this PE is to develop and demonstrate the technologies needed to meet the Marine Corps' unique responsibility of training and equipping the Marine Air/Ground Task Force (MAGTF) for expeditionary maneuver Warfare. This PE provides the knowledge base to support Advanced Technology Development (6.3) and is the technology base for future expeditionary warfare capabilities. This PE supports the Expeditionary Force Development System of the Marine Corps Combat Development Command and responds directly to the Marine Corps Science and Technology (S&T) process. The Future Naval Capabilities (FNC) process is supported and funds are programmed accordingly. The core program also supports Discovery and Invention (D&I) and Innovation and Transformation (I&T). Within the Naval Transformation Roadmap, this investment will achieve key transformational capabilities required by Sea Strike, Sea Basing, Sea Shield, and ForceNet as well as enable the Ship to Objective Maneuver (STOM) and Persistent Intelligence, Surveillance and Reconnaissance (ISR).

Through 2005, the focus of the FNC efforts has been on satisfying technology gaps related to Power Projection and Littoral Combat. As the products of these efforts are transitioned to acquisition programs of record, the focus of the FNC within this PE in FY 2006 and beyond will be on technology related to Urban, Asymmetric, and Expeditionary Operations (UAEO). The UAEO Capability Gap is a science and technology developmental area that is of the highest importance to Marine Corps operations in Iraq and Afghanistan. The UAEO Capability Gap is one of 25 prioritized Capability Gaps (prioritized by OPNAV N-6/7 and the Marine Corps Combat Development Command) that are made up of Enabling Capabilities (ECs) and supporting products. The UAEO technology gap is being pursued as part of an overall effort that addresses the Sea Strike Capability Gap.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M
PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M
PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	37,036	37,590	37,516
Congressional Action	0	1,000	0
Congressional Undistributed Reductions/Rescissions	-28	-574	0
Execution Adjustments	-2,581	0	0
FY 2005 SBIR	-495	0	0
Program Adjustments	8	0	0
Rate Adjustments	0	0	225
FY 2007 President's Budget Submission	33,940	38,016	37,741

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The primary objective of this Program Element is the development of technologies to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare. The program consists of a collection of projects categorized by critical Warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
MARINE CORPS LANDING FORCE TECHNOLOGY	32,011	37,016	37,741	39,414	40,245	41,287	42,229

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project is organized into six activities which are represented as five Expeditionary Warfighting Capability Areas and the Littoral Combat/Power Projection (LC/PP) FNC. The five Expeditionary Warfighting Areas support the Discovery and Invention (D&I) and the Innovation and Transformation (I&T) investment. The LC/PP FNC supports the Exploitation and Deployment (E&D) investment.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT/POWER PROJECTION	16,684	21,968	21,464

This activity provides the capability for the demonstration and transition of technologies developed through the Marine Corps S&T program directly to an acquisition program of record.

Through 2005 the focus of the FNC efforts has been on satisfying technology gaps related to Power Projection and Littoral Combat. As the products of these efforts are transitioned to acquisition programs of record, the focus of the FNC within this PE in FY 2006 and beyond will be on technology related to Urban, Asymmetric, and Expeditionary Operations (UAEO). The UAEO Capability Gap is S&T developmental area that is of the highest importance to Navy and Marine Corps operations in Iraq and Afghanistan. The UAEO Capability Gap is one of 25 prioritized Capability Gaps (prioritized by OPNAV N-6/7 and the Marine Corps Combat Development Command) that are made up of Enabling Capabilities (ECs) and supporting products. The UAEO technology gap is being pursued as part of an overall effort that addresses the Sea Strike Capability Gap. This activity includes support for the Urban, Asymmetric Operations-related to FNC Enabling Capabilities and for Improvised Explosive Devices, Transparent Urban Structures, Modular Scalable Effects Weapons, Defense of Harbor and Near-shore Naval Infrastructure Against Asymmetric Threats, Fortified Position Security (Asymmetric Threat Weapon, Water

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

Inflatable Barrier, and Unambiguous Warning Devices), Position Location Information and Hostile Fire Detection and Response. Some of the efforts in this activity transition to the following PEs 0602114N, 0602235N, 0602123N, 0603235N, and 0603640M.

Increase in FY 2005 to FY 2006 is due to FNC realignments.

FY 2005 Accomplishments:

- Continued development of algorithms for use in discriminating between individual single channel Radio Frequency (RF) emitters on the battlefield and determining their locations.
- Continued development of algorithms to derive maps of water depths, current speed and direction, terrain elevation, and sandbar and obstacle location using digital imagery from airborne Intelligence, Surveillance, Reconnaissance (ISR) assets.
- Continued development of advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability.
- Continued development and testing of target acquisition technologies for achieving interoperability among US/Joint/Coalition close air support platforms and commence transition to acquisition.
- Continued Expeditionary Fighting Vehicle (EFV) obstacle avoidance subsystem design, integrate subsystems and prepare for demonstration.
- Continued hostile fire detection and counter-fire subsystem design (GUNSLINGER).
- Continued development and integration of network monitoring and management tools technology.
- Continued integration and demonstration of innovative relays beyond line of sight (BLOS) in the areas of wideband communications and advanced modular systems.
- Continued integration and testing of secure mobile network/wireless LAN technologies, including advanced protocols, frequency conversion and power amplification. (FY 2006 efforts funded by PE 0603640M)
- Continued development of expeditionary maneuver planning and decision-making tools for Marine ground forces.
- Completed development of technologies to enhance lethality and extend range for mortar munitions; provided software module/injector for Command and Control Personal Computer (C2PC) to MARCORSYSCOM PM Expeditionary Fire Support System (EFSS).
- Initiated effort in Distributed Common Ground/Surface System (DCGS) to improve migration of tactical intelligence systems (sensor networks), integrated forecasting and planning and battlefield information integration.
- Initiated investigation of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

- Initiated development of a fires coordination architecture to network existing expeditionary fires systems to enable MAGTF/Joint Fires. (Concurrent effort funded by PE 0602236N)
- Initiated development of land mine countermeasure insensitive munitions technology.
- Initiated development of integrated vehicle self-defense system to defeat incoming Rocket Propelled Grenades (RPGs).

FY 2006 Plans:

- Continue effort in DCGS that involves the migration of tactical intelligence systems (sensor networks) to a net-ready architecture and the development of enterprise services that translate this data. (Effort transitions to PE 0603235N in FY 2007).
- Continue development of advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability.
- Continue investigation of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield.
- Continue development of target acquisition architecture, information exchange, connectivity and interoperability of target hand-off and fire control and coordination systems. (Previous and concurrent efforts funded by PE 0603640M; FY 2007 effort funded by PE 0602114N)
- Continue development of a fires coordination architecture to network existing expeditionary fires systems to enable MAGTF/Joint Fires. (Concurrent effort funded by PE 0602236N)
- Continue design and test of hostile fire detection and counter-fire system (GUNSLINGER). (FY 2007 effort funded by PE 0602114N.)
- Continue transition of expeditionary maneuver planning and decision-making tools for Marine ground forces to Navy and Marine Corps acquisition.
- Continue development of integrated vehicle self-defense system technologies to defeat incoming Rocket Propelled Grenades (RPGs).
- Continue development and fabrication of full scale demonstration systems for landmine countermeasure insensitive munitions technology.
- Continue development and integration of network monitoring and management tools technology and transition to acquisition. (FY 2007 effort funded by PE 0602235N.)
- Continue integration and demonstration of innovative relays (BLOS) in the areas of wideband communications and advanced modular systems.
- Complete development of algorithms and commence modifications of hardware and software for use in discriminating between individual single channel RF emitters on the battlefield and determining their

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

locations; provide algorithms to MARCORSYSCOM Program Manager (PM) INTEL.
- Complete development of algorithms to derive maps of water depths, current speed and direction, terrain elevation, and sandbar and obstacle location using digital imagery from airborne ISR assets for MARCORSYSCOM PM INTEL and initiate integration testing with Intelligence, Surveillance and Reconnaissance (ISR) platform (tactical littoral sensing).
- Complete development and begin transitioning EFV obstacle detection capability to EFV Directing Reporting Program Manager (DRPM).
- Initiate for the development of tactical ISR data structures and pattern recognition algorithms. (FY 2007 effort funded by PE 0602114N)
- Initiate advanced concept development devices to alert approaching targets with an unambiguous warning that, if ignored, will clearly demonstrate hostile intent of the approaching target. (Realigned from PE 0602123N)

FY 2007 Plans:

- Continue development and fabrication of full scale demonstration systems for landmine countermeasure insensitive munitions technology.
- Continue development of integrated vehicle self-defense system to defeat incoming RPGs.
- Continue integration and demonstration of innovative relays (BLOS) in the areas of wideband communications and advanced modular systems. Complete transition to the acquisition community. (Transitions to PE 0602235N.)
- Continue advanced concept development devices to alert approaching targets with an unambiguous warning that, if ignored, will clearly demonstrate hostile intent of the approaching target. (Realigned from PE 0602123N)
- Complete modifications of hardware and software for use in discriminating between individual single channel RF emitters on the battlefield and determining their locations and extend the developed capability to other modulations; deliver to MARCORSYSCOM PM INTEL.
- Complete development, integration and transition of airborne ISR (tactical littoral sensing) capability to MARCORSYSCOM PM INTEL.
- Complete transition of expeditionary maneuver planning and decision-making tools for Marine ground forces to Navy and Marine Corps acquisition; Expeditionary Decision Support System (EDSS) transitions to MARCORSYSCOM and PMS 490. (Transitions to PE 0602114N.)
- Complete development of a fires coordination architecture to network existing expeditionary fires systems to enable MAGTF/Joint Fires; transition multiple software injectors to MARCORSYSCOM PM GC2. (Transitions to PE 0602114N.)
- Complete investigation of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield; provide prototype packaging to MARCORSYSCOM PM AMMO. (Transitions to PE

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

0602114N.)
- Complete development and transition advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability to acquisition; provide prototype mortar tube, bipod and baseplate to MARCORSYSCOM PM EFSS. (Transitions to PE 0602114N.)
- Complete integration and testing of secure mobile network/secure wireless LAN technologies, including advanced protocols, frequency conversion and power amplification; provide advanced networking protocols and antennas to MARCORSYSCOM PM COMM. (Previous effort funded by PE 0602236N and PE 0603236N)
- Initiate modular scalable effects weapons technologies development.
- Initiate transparent urban structure ‘see thru the wall’ and image and mapping technologies development.
- Initiate development of an integrated company level Urban Sensor Suite (Automated Control of Large Sensor Networks). (Transitions to PE 0602235N.)
- Initiate detect and ID facilities technology development (Transparent Urban Structures)
- Initiate decision aids technology development. (Transparent Urban Structures)
- Initiate indirect prototype technology development. (Modular Scalable Effects Weapon)

	FY 2005	FY 2006	FY 2007
MANEUVER	5,385	5,372	5,994

The Maneuver Thrust Area focuses on the development, demonstration, and transition of technologies that will increase the warfighting capabilities and effectiveness of the MAGTF. This Thrust aims at capturing emerging and “leap ahead” technologies in the areas of mobility, materials, propulsion, survivability, durability, signature reduction, modularity, and unmanned systems. Special emphasis on survivability technologies for the defeat of small arms, Improvised Explosive Devices (IEDs), mine blast, and rocket propelled grenades continue to be incorporated in this thrust area. A concentrated effort has also been made in the development of modeling and simulation tools that integrate many different physics based modeling systems with rigorous operational analysis simulations to accurately define a system’s performance characteristics. These tools will aid in defining the trade space for emerging technologies and assist in providing the Program Manager insight and guidance into pursuing future technologies. Finally, this technology thrust area also seeks to develop technologies to enhance combat vehicle crewman effectiveness and situational awareness through the incorporation of advanced autonomous vehicle functions triggered directly by the cognitive state of the operator. Beginning in FY 2008, Mine Counter Measures (MCM) will become a separate activity. Presently, MCM supports and enhances the maneuver and force protection Marine landing forces with the development of technologies to enable detection, neutralization, breaching, and clearing of mines, IEDs, and Unexploded Ordnance (UXO) from the beach exit to inland objectives. MAGTF MCM is a functional component of Naval

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

Expeditionary Maneuver Warfare and includes Ship to Objective Maneuver, Expeditionary Operations from a Sea Base, sustained Operations Ashore, Urban and Asymmetric Operations, and Operations other than War.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

FY 2005 Accomplishments:

- Continued lightweight Expeditionary Systems Materials (ESM) efforts to determine feasibility of scaling and producing candidate structural armor.
- Continued simulation based acquisition tool for conducting future combat vehicle design tradeoffs.
- Completed development of Nuclear Quadrupole Resonance (NQR) mine detection technology in support of the Advanced Mine Detector Program. Transitioned half passage adiabatic advance NQR excitation schemes to the Advanced Mine Detector program in PE 0603640M.
- Initiated Augmented Cognition efforts related to ground vehicle applications.
- Initiated and completed combat vehicle survivability study to explore armor solutions for application to current and future combat vehicles.
- Initiated Energetic Non-Explosive Reactive Armor (E-NERA) and Advanced Electro-magnetic Armor (AEMA) technology development efforts.
- Initiated USMC participation in Explosion Resistant Coatings (ERC) ACTD.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete modeling and simulation and analysis of alternative combat vehicles concepts.
- Complete USMC participation in Explosion Resistant Coatings (ERC) ACTD.
- Initiate S&T programs to address MAGTF Land MCM Master Plan capability gaps.
- Initiate technologies for stand-off detection and neutralization of mines, IEDs, and UXO.
- Initiate technologies to defeat side/top attack and advanced fuse mines through signature reduction and advanced signature duplication.
- Initiate development of computational models to scale the effects of small-scale explosives tests to full-scale landmine explosions in order to study mine blast effects on advanced vehicle geometry.
- Initiate development of modeling tools to accurately determine loading and fragmentation effects on targets from mine explosions.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

- Initiate development of technologies for improved survivability adn mobility in support of the Combat Tactical Vehicle (CTV) program.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Initiate mobility enhancement development effort for current and future light and medium weight Marine Corps vehicle programs.

	FY 2005	FY 2006	FY 2007
HUMAN PERFORMANCE, TRAINING & EDUCATION (HPT&E)	2,771	1,688	1,993

This activity develops advanced training technology and technologies that enhance neural and cognitive aspects of human performance including cognitive task analysis, tactical decision-making, modeling, simulation, range instrumentation and synthetic environment generation. We intend to change the name of this activity in FY 2008 to "Human Performance, Training and Survivability" to better describe its program/projects. Some projects will migrate from the Firepower activity during FY 2008.

FY 2005 Accomplishments:

- Continued evaluation and development of tools to support real-time cognitive and behavioral assessment (augmented cognition) and improvement of individuals and teams during operations and training.
- Continued to research and develop tools to rapidly generate synthetic environments (3D databases, database correlation techniques) within and urban landscape applicable to Military Operations in Urban Terrain (MOUT).
- Completed development of a Joint Terminal Attack Controller (JTAC) Tactical Decision Simulation (TDS).
- Completed development of technologies supporting rapid and dynamic generation of 3D real-world terrain features suitable for Marine Corps training application.
- Completed the development of Radio Frequency (RF) tracking and video tracking fusion for enhanced situational awareness in a MOUT training environment.
- Initiated development of realistic training environments that supplement field training and provide instructors with advanced situational awareness, after action review, and mission preview capabilities.
- Initiated research to develop a comprehensive performance fidelity architectures for mapping training objectives, strategies and requirements onto training system specifications.
- Initiated research in the area of team training task analyses and training effectiveness evaluation

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

techniques to develop more effective training systems for MOUT.

FY 2006 Plans:

- Continue development of FY 2005 efforts less those noted as completed above.
- Initiate research to develop metrics for improving an individual's operational performance in stressful urban environments including use for selection and recruiting to that mission specialty.
- Initiate research to evaluate the feasibility of integrating augmented reality technologies into current and emerging training systems.

FY 2007 Plans:

- Continue development of FY 2006 efforts less those noted as completed above.
- Complete development of a performance fidelity architecture, applying the model to develop guidelines and specifications for a to-be-built training system.
- Complete development of tools to rapidly generate synthetic environments (3D databases, database correlation techniques) within an urban landscape (MOUT), and apply to existing training programs (i.e., Virtual Technologies and Environments—(VIRTE) Demo III).
- Initiate the development of training effectiveness measures and techniques as applied to disparate, multi-platform, multi-mission team training.

	FY 2005	FY 2006	FY 2007
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (C4ISR)	2,771	2,935	3,113

This activity provides technologies for secure, robust, self-forming, mobile communications networks (FORCEnet); distributed computing to support information dissemination to all echelons; and sensors, software and data processing to support formation of appropriate common picture. Emphasis for Marine Corps efforts includes power management, low detect ability, size and weight constraints, and interoperability within the joint environment. Beginning FY 2008, Intelligence, Surveillance and Reconnaissance (ISR) will become a separate activity leaving the focus of this effort in Command, Control, Communications, and Computers (C4).

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

FY 2005 Accomplishments:

- Continued development of conformal, broadband, Ultra High Frequency-Very high Frequency (UHF-VHF) antennas.
- Continued development of network management capabilities for the low-bandwidth, heterogeneous communication environment.
- Continued development of low-probability of detection random noise communications waveforms.
- Completed development of network security technologies for low-bandwidth distributed environments. Efforts will continue to mature this technology within PE 0603640M.
- Completed development of network mobility capabilities for the low-bandwidth, heterogeneous communication environment. Efforts will continue to mature this technology within PE 0603640M.
- Initiated development of communications technologies for high attenuation and multi-path environments.
- Initiated development of technology to provide position location in Global-Positioning System restricted environments.

FY 2006 Plans:

- Continue development of FY 2005 efforts less those noted as completed above.
- Complete development of conformal, broadband, UHF-VHF antennas that was started in FY 2004. Efforts will continue to mature this technology within PE 0603640M.
- Initiate development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data.
- Initiate development of low power consumption urban sensing technologies.

FY 2007 Plans:

- Continue development of FY 2006 efforts less those noted as completed above.
- Complete development of low-probability of detection random noise communications waveforms that was started in FY 2004. Efforts will continue to mature this technology within PE 0603640M.
- Complete development of communications technologies for high attenuation and multi-path environments. Efforts will continue to mature this technology within PE 0603640M.
- Complete development of technology to provide position location in GPS restricted environments. Efforts will continue to mature this technology within PE 0603640M.
- Complete development of network management capabilities for the low-bandwidth, heterogeneous communication environment that was started in FY 2004. Efforts will continue to mature this technology within PE 0603640M.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

- Continue development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data.
- Continue development of low power consumption urban sensing technologies.
- Initiate development of information management technologies to reduce information overload.
- Initiate development of urban sensing technologies to detect weapons at distance.

	FY 2005	FY 2006	FY 2007
FIREPOWER	2,725	2,639	2,702

This activity develops technology for application on current and future expeditionary weapons and elements of the kill chain. It includes, but is not limited to, the following technologies: fuze, fire control, launch/propulsion, lethality, and accuracy.

FY 2005 Accomplishments:

- Initiated development of Microelectromechanical Systems (MEMS) concepts to comply with OSD submunition reliability and Navy Weapons Systems Explosive Safety Review Board requirements for submunitions to be stored aboard U.S. Navy ships. This includes development of a MEMS process micro detonator enabling technology.
- Initiated development of a concept for an Insensitive Munition (IM) propulsion system to enable firing a shoulder launched rocket from an enclosed space. Establish initial feasibility and practicality of solutions for improving firepower effectiveness.
- Initiated an assessment of current and emerging technologies to be incorporated into a Marine Advanced Combat Headborne System Initiative (MACHSI). The goal is to increase warfighter head and neck protection while enhancing warfighter comfort and minimizing warfighter encumbrance.

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Complete MACHSI 6.2 effort and transition to 6.3 effort in PE 0603640M.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Initiate assessment of current and emerging IM technologies for broad application to munitions for improving

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

firepower effectiveness while increasing affordability and decreasing logistical burden in support of expeditionary warfare.
- Initiate an investigation of the scalability of variable effects conventional munitions technology for improving firepower effectiveness while increasing affordability and decreasing logistical burden in support of expeditionary warfare.

	FY 2005	FY 2006	FY 2007
LOGISTICS	981	1,688	1,735

This activity supports Marine Corps Expeditionary Logistics which is the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. Expeditionary Logistics replaces mass with assured knowledge and speed, is equally capable ashore or afloat in austere environments, and is fully scalable to meet uncertain requirements. Expeditionary Logistics logically divides into five pillars: deployment support, force closure, sustainment, reconstitution/redeployment, and command and control. These pillars are thoroughly integrated and perpetually related in execution.

FY 2005 Accomplishments:

- Continued research into using polymer gel electrolytes and novel air electrodes in next generation metal air batteries to demonstrate the feasibility of performance improvement.
- Completed exploratory development of individual handheld water purification and desalinization devices to demonstrate the feasibility of performance improvement. Final reports are under review by USMC and Army PMs for potential initiation of a joint acquisition program of record.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Initiate developing and assessing concepts that permit precision delivery of logistics assets while also reducing the logistics footprint ashore. After reconsideration, this project was moved from FY 2006 PE 0603640M.
- Initiate development of an alternate power source to reduce logistics footprint and increase sustainability of Marine expeditionary forces.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete research into using polymer gel electrolytes and novel air electrodes in next generation metal air batteries to demonstrate the feasibility of performance improvement.

	FY 2005	FY 2006	FY 2007
FUTURE CONCEPTS, TECHNOLOGY ASSESSMENT, AND ROADMAPPING	694	726	740

This activity supports the planning and integration of technology development efforts across the entire Program Element. In conjunction with the Concepts Based Capabilities System and the Marine Corps Warfighting Laboratory, unique and novel concepts for advanced Warfighting are developed and validated. Effectiveness analyses are conducted to identify the synergistic effects that can be achieved through the integration of emerging technology with innovative tactics, doctrine, and techniques. Technology Assessments are conducted to determine the supporting technologies that have the highest impact across the warfare areas, and warrant further investment within this Program Element. Technology Roadmapping is conducted to help identify opportunities to leverage technology development within the Department of the Navy and the Department of Defense, as well as, with the commercial sector and university communities. The resultant Technology Investment Strategy is developed and used to guide out-year technology development efforts.

FY 2005 Accomplishments:

- Initiated Technology Assessments associated with the Urban Asymmetric and Expeditionary Warfare Capability Gap.
- Initiated the integrated planning of concepts and technology development.

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Initiate Technology Assessment and Roadmapping of the Maneuver; and Human Performance, Training and Education Thrust Areas.
- Initiate development of the Expeditionary Maneuver Warfare Investment Strategy.
- Initiate Technology Assessments and Roadmapping within Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR); and Firepower Thrust Areas of the PE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

FY 2007 Plans:

- Continue all efforts of FY 2006.
- Complete Technology Assessments and Roadmapping of selected Thrust Areas.
- Initiate and complete implementation of an S&T Management Information System.
- Initiate and complete Technology Assessment of the Combating Terrorism portfolio.

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ADVANCED LEAD ACID BATTERY DEVELOPMENT FOR MILITARY VEHICLES	966	1,000

FY 2005 - Explored novel approaches including the use of a horizontal plate design, and conductive additives to the electrodes.

FY 2006 - This effort supports advanced lead acid battery development for military vehicles.

	FY 2005	FY 2006
EXPEDITIONARY FORCE INFRASTRUCTURE INITIATIVE (EFI)	963	0

The EFI2 effort was designed to develop a large placement and dispersion salt water capability, as well as an austere surface treatment capability in support of expeditionary water crossing missions. This new surface treatment approach using lightweight composite materials is particularly important in support of Marine amphibious operations in areas of extremely soluble soils. The EFI2 effort was also designed to assess and develop effective techniques for large batch processing of composite repair material in the rapid repair of airfield runways in an expeditionary environment. This will improve mission readiness by getting airfields back on line quicker. It will also reduce the use of matting on expeditionary airfields thereby decreasing damage to aircraft airframes upon landing.

C. OTHER PROGRAM FUNDING SUMMARY:
ALL: NAVY RELATED RDT&E: This program adheres to Tri-Service Reliance Agreements in Chemical/Biological

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

Defense; Command, Control and Communications; Conventional Air/Surface Weaponry; Electronic Devices; Ground Vehicles; Ships and Watercraft; Manpower and Personnel; and Training Systems.

PE 0204163N (Fleet Telecommunications (Tactical))
PE 0206313M (Marine Corps Communications Systems)
PE 0206623M (Marine Corps Ground Combat/Supporting Arms Systems)
PE 0601152N (In-House Laboratory Independent Research)
PE 0601153N (Defense Research Sciences)
PE 0602235N (Common Picture Applied Research)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0603235N (Common Picture Advanced Technology)
PE 0603612M (USMC Mine Countermeasures Systems - Adv Dev)
PE 0603635M (Marine Corps Ground Combat/Support System)
PE 0603236N (Warfighter Sustainment Advanced Technology)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))
PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)

NON NAVY RELATED RDT&E:
PE 0603004A (Weapons and Munitions Advanced Technology)
PE 0603005A (Combat Vehicle and Automotive Advanced Technology)
PE 0603606A (Landmine Warfare and Barrier Advanced Technology)

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: HUMAN SYSTEMS TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
HUMAN SYSTEMS TECHNOLOGY	1,446	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element is funded in its entirety by Congressional Adds.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: HUMAN SYSTEMS TECHNOLOGY

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	1,485	0	0
Congressional Undistributed Reductions/Rescissions	-1	0	0
FY 2005 SBIR	-38	0	0
FY 2007 President's Budget Submission	1,446	0	0

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: HUMAN SYSTEMS TECHNOLOGY

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
SEAPRINT	1,446	0

FY 2005 Accomplishments: SEAPRINT ensured all aspects of Human System Integration (HSI) with respect to Navy platforms/systems were addressed and facilitated the effectiveness of HSI standards. SEAPRINT focused on the integration of human considerations into the system acquisition to (1) enhance human/system design, (2) reduce life cycle ownership costs and (3) optimize total system performance. Funds were used to validate HSI processes/tenets adapted for Navy platforms from the Army Imprint/Manprint Program.

C. OTHER PROGRAM FUNDING SUMMARY:

D. ACQUISITION STRATEGY:

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY	3,858	1,500	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element is funded in its entirety by Congressional Adds.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	3,962	0	0
Congressional Action	0	1,500	0
Congressional Undistributed Reductions/Rescissions	-3	0	0
FY 2005 SBIR	-102	0	0
Program Adjustments	1	0	0
FY 2007 President's Budget Submission	3,858	1,500	0

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
AGILE MANUFACTURING CENTER FOR CASTINGS TECHNOLOGY - KEYPORT NAVAL BASE	964	1,500

FY 2005 Accomplishment: Effort supported the DoD Agile Manufacturing Center for Castings Technology at the Naval Undersea Warfare Center, Newport, RI.

FY 2006 Plan: This effort supports the agile manufacturing center for casings technology.

	FY 2005	FY 2006
FORMABLE ALIGNED CARBON THERMOSETS (FACTS)	1,447	0

FY 2005 Accomplishment: Effort developed data and information required to design and fabricate parts for Navy aircraft using the Formable Aligned Carbon ThermoSet (FACT) material.

	FY 2005	FY 2006
POROUS MATERIALS	1,447	0

FY 2005 Accomplishment: This effort determined the corrosion-fatigue crack growth kinetics, studied the stress-corrosion cracking resistance and investigated the deformation processes and cracking mechanisms in bi-modal grain structured aluminum alloys. This work is essential to efforts to utilize new, very high strength aluminum alloys in future Navy and Marine Corp combat vehicles and ships. It provided data on fatigue and stress corrosion cracking on nanostructured aluminum alloys.

C. OTHER PROGRAM FUNDING SUMMARY:

D. ACQUISITION STRATEGY:

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N
PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
COMMON PICTURE APPLIED RESEARCH	100,205	106,391	68,352	72,732	72,115	73,097	72,926

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Work in this project examines technologies that enable the transformation to network centric warfare, which relies on information to connect assets and provide timely and accurate understanding of the environment. The mission area requirements for rapid, accurate decision-making; dynamic, efficient, mission-focused communications and networks; and pervasive and persistent sensing drive FORCEnet S&T investments. The focus is S&T enablers that provide decision making and mission execution to achieve battlespace superiority. The project seeks to develop hardware and software technologies that (1) identify and integrate informational content from multi-media sources including images, and intelligence sources; (2) integrate massive amounts of information; and (3) provide automatic correlation, fusion, and insight to support user-cognitive processes. Particular emphasis will be placed on automating the association of objects and events in the battlespace and automatically transforming this information into actionable knowledge (e.g., indications and warnings of intent). In current and future operational environments such as Global War on Terrorism (GWOT) and Maritime Domain Awareness (MDA), warfighters require technologies evolved to support information needs regardless of location and consistent with the user’s level of command or responsibility and operational situation. Net-centric operations include communications and information assurance capabilities to enable all-source data access, multi-source processing, and tailored dissemination to C2 and ISR users across the network. The operational benefits sought are an increased speed, accuracy and precision of command; distributed self-synchronization; flexibility and adaptability to an operational situation; and decision superiority. Technologies emphasized provide warfighters with a robust, secure, mission responsive network; integrated information leading automated courses of action; and presentation of knowledge to speed understanding. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N
PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH

This program explores and demonstrates technologies that enable options for FORCEnet, Sea Shield, and Sea Strike pillars. This program element contains investments in the following FORCEnet, Sea Strike and Sea Shield enabling capabilities: Hostile Fire Detection and Response, Next Generation Command, Control and Decision Support, Combat ID Information Management of coordinated Electronic Surveillance, Combat ID in the Maritime Domain to Reveal Contact Intent, Automated Control of Large Sensor Networks, and Real-Time Long Range Air Defense Combat ID in Support of Early Engagement. In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet, “Persistent Intelligence, Surveillance, and Reconnaissance,” “Time Sensitive Strike,” “Sea Based Information Operations,” “Sea Strike” Ship-to-Objective Maneuver, and “Sea Shield” Theater Air and Missile Defense.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N
PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	102,107	57,693	63,141
Congressional Action	0	49,650	0
Congressional Undistributed Reductions/Rescissions	-78	-952	0
Execution Adjustments	-414	0	0
FY 2005 SBIR	-1,410	0	0
Program Adjustments	0	0	-5,284
Program Realignment	0	0	10,515
Rate Adjustments	0	0	-20
FY 2007 President's Budget Submission	100,205	106,391	68,352

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
Performance metrics are discussed within the R2a.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
COMMON PICTURE APPLIED RESEARCH	58,735	56,741	68,352	72,732	72,115	73,097	72,926

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Work in this project examines technologies that enable the transformation to network centric warfare, which relies on information to connect assets and provide timely and accurate understanding of the environment. The mission area requirements for rapid, accurate decision-making; dynamic, efficient, mission-focused communications and networks; and pervasive and persistent sensing drive FORCEnet S&T investments. The focus is S&T enablers that provide decision making and mission execution to achieve battlespace superiority. The project seeks to develop hardware and software technologies that (1) identify and integrate informational content from multi-media sources including images, and intelligence sources; (2) integrate massive amounts of information; and (3) provide automatic correlation, fusion, and insight to support user-cognitive processes. Particular emphasis will be placed on automating the association of objects and events in the battlespace and automatically transforming this information into actionable knowledge (e.g., indications and warnings of intent). In current and future operational environments such as Global War on Terrorism (GWOT) and Maritime Domain Awareness (MDA), warfighters require technologies evolved to support information needs regardless of location and consistent with the user’s level of command or responsibility and operational situation. Net-centric operations include communications and information assurance capabilities to enable all-source data access, multi-source processing, and tailored dissemination to C2 and ISR users across the network. The operational benefits sought are an increased speed, accuracy and precision of command; distributed self-synchronization; flexibility and adaptability to an operational situation; and decision superiority. Technologies emphasized provide warfighters with a robust, secure, mission responsive network; integrated information leading automated courses of action; and presentation of knowledge to speed understanding. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower.

This project explores and demonstrates technologies that enable options for FORCEnet, Sea Shield, and Sea Strike pillars. This project contains investments in the following FORCEnet, Sea Strike and Sea Shield enabling capabilities: Hostile Fire Detection and Response, Next Generation Command, Control and Decision Support, Combat ID Information Management of coordinated Electronic Surveillance, Combat ID in the Maritime

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

Domain to Reveal Contact Intent, Automated Control of Large Sensor Networks, and Real-Time Long Range Air Defense Combat ID in Support of Early Engagement. In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet, “Persistent Intelligence, Surveillance, and Reconnaissance,” “Time Sensitive Strike,” “Sea Based Information Operations,” “Sea Strike” Ship-to-Objective Maneuver, and “Sea Shield” Theater Air and Missile Defense.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
NETWORK COMMAND, CONTROL AND COMBAT SYSTEMS	19,455	12,076	16,261

This initiative explores development of advanced technologies that contribute to integrated decision-making and mission execution to achieve battlespace superiority. In current and future operational environments, such as the Global War on Terrorism and Maritime Domain Awareness, warfighters require technologies evolved to support information needs regardless of location and consistent with the user’s level of command or operational situation. To achieve this, it must be possible to automate understanding of the battlespace by identifying objects, determining relationships among the objects, assessing intent, and automatically generating courses of action with associated risks and uncertainty. This initiative focuses on information integration, examining the critical S&T needs of automatic association and merger of information for unified presentation; automated recognition and cueing for significant patterns of information, computer-aided reasoning for task-oriented information dissemination; timely, accurate information and sensor fusion from heterogeneous sources, as well as supporting technologies to provide the understanding and relationship of different entities shown in the battlespace and their collective intent. This initiative will focus on advanced or novel approaches for processing and fusing information from disparate sources (e.g., images, intelligence sources); optimal decision aids incorporating rigorous decision theory and automated inference and reasoning; and assuring information integrity and availability according to mission objectives.

FY 2006 decreases because many projects will be transitioning to Systems Commands and other Sponsors as well as the realignment of Swampworks and Tech Solutions efforts and funding to PE 0603578N effective FY 2006. The increase in funds between FY 2006 and FY 2007 results from increased emphasis on information integration. FY 2005 through FY 2007 also reflects the realignment of efforts previously reported under the Computing and

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

Advanced Sensing activity.

FY 2005 Accomplishments:

• Continued the development of algorithms and demonstration of data reduction through joint classification and feature optimization, realizing transfer of data to information, realizing A/I vis-a-vis Analog/Digital data (reduced bandwidth requirements and reduced burden on analysts and warfighters).
• Continued the development of a feature extraction module that segments the video based on video mosaicing.
• Continued the development of algorithms with Naval/Joint imagery systems to handle video metadata, which includes Global Positioning System, time, and sensor information.
• Continued the development of recommendations for standardizing the storage and linking of feature descriptions within a common database framework.
• Completed the evaluation of value of three dimensional techniques to enhance visualization technology.
• Completed the worst-case detection and conflict avoidance experimentation for the Real Time Deconfliction effort.
• Initiated the development and characterization of a new target detection and recognition algorithms to exploit higher dimensional data (spatial, temporal, and spectral) within the Network Centric Warfare framework. Approach utilizes advanced correlation approaches to provide improved target detection and recognition performance by integrating multiple sensor measurements.
• Initiated the development of a suitable ontology for exercising large-scale distributed situational threat awareness in Naval battlespace environments.
• Initiated the development of a Case-Based Reasoning simulation/model for implementing situation, threat awareness fusion solutions and a Bayesian Network inference engine for manipulating uncertainty and learning from data.
• Initiated the development of an initial prototype for an information sharing infrastructure that maintains data integrity and confidentiality for enclaves of networked workstations running Commercial Off the Shelf (COTS) operating systems and applications.
• Initiated the demonstration and conducted image registration error analysis for the multi-resolution and multi-scale image processing effort.
• Initiated the augmentation of the real world information with computer-generated information in the Battlefield Augmented Reality System effort. The activity designed a modular framework to support the system design and enables the insertion of custom scheduling and replication solutions. Other efforts focused on the middleware layer to support emerging network centric sensor-to shooter systems.
• Initiated development of automated methods for identifying significant changes between temporally separated

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

images (not video) to extend work on automatic target recognition and pattern recognition into change detection algorithms.
• Initiated demonstration of a FORCEnet limited objective experiment the application of new techniques of discrete optimization, statistical discrimination, and artificial intelligence for the resource allocation of weapons. Compared initial results with high fidelity physics based models for threat and anti-threat weapon systems for continued development of Anti-Air Warfare optimization algorithms.

• Completed development of technology to improve fidelity in Marine Infantry combat simulators via virtual locomotion and collision detection. (NRL)
• Continued research and demonstrations of modulated near-infrared (IR) optical retroreflector data to develop spacecraft to spacecraft data exchange techniques. (NRL) (Previously reported under the Computing and Advanced Sensing activity.)
• Continued development of "through-the-sensor" exploitation techniques to obtain environmental information from shipboard radars, and use of that information in nowcasting. (NRL) (Previously reported under the Computing and Advanced Sensing activity.)
• Continued to evaluate improved method to automatically account for atmospheric effects on hyperspectral data and apply anomaly detectors, matched filters, and new algorithms for hyperspectral target detection. (NRL) (Previously reported under the Computing and Advanced Sensing activity.)
• Continued development of technology for improving reliable system to survive Information Warfare attacks. (Previously reported under the Computing and Advanced Sensing activity.)
• Initiated development of technology for improved steganography and watermarking. (NRL) (Previously reported under the Computing and Advanced Sensing activity.)
• Initiated development of technology for improving voice data interpretation and presentation to cope with audio information overload in Navy Systems. (NRL)
• Initiated development of technology to improve collaborative operational planning for tactical users using Head-Up Displays. (NRL)
• Initiated development of technology for improving face recognition technology via enhanced image registration software. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

FY 2006 Plans:

• Continue all efforts from FY 2005, less those noted as completed above.
• Initiate development of sensor management algorithms that reduce the amount of labeled training data required, employing semi-supervised classifier and active learning techniques motivated by asymmetric threat, which limited training data anticipated.
• Initiate demonstration of predictive surface platform threat behavior algorithms and software employing techniques using pattern recognition on geospatial and attribute data. Also develop autonomous monitoring and reporting of high interest and anomalous maritime vessels.
• Initiate demonstration of a trusted data store which maintains data pedigree and detects anomalies in a limited objective experiment.
• Initiate efforts in ontology-based information fusion for enhanced situational awareness and classification-based knowledge discovery.
• Initiate efforts in Joint Director of Laboratory's Data Fusion Model Level 1/2/3 data fusion using abductive reasoning, Bayesian networks, agent-based techniques, statistical-based methods, and other approaches.
• Initiate efforts in automated image understanding that use active computations and visual pattern recognition for networked target recognition systems in maritime domain awareness.
• Initiate efforts in the automated integration disparate sources of information that involve data mining methods and game theory.

• Complete development of new algorithms for hyperspectral target detection in oblique geometries. (NRL)
• Initiate the implementation of a real-time anti-ship missile (ASM) state assessment capability against modern threats by embedding algorithms in a real-time processor. (NRL) (Previously reported under the Computing and Advanced Sensing activity.)

FY 2007 Plans:

• Continue all efforts from FY 2006, less those noted as completed above.
• Initiate demonstration of anomaly detection, feature-based target tracking, track-to-pattern association and scoring, track-to-group clustering, pattern discovery and learning, pattern templates/descriptions and predictive modeling tools in a limited objective experiment.
• Initiate development of an interface between the Level 1 and Level 2/3 data fusion processes across federated service oriented architectures.
• Initiate development of new data schemas and methods to allow more efficient assembly of a Common

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

Operational Picture (COP) integrating informational content from images, track data, intelligence and incomplete track data.
• Initiate development of semi-supervised detection algorithms for multi-sensor imagery, video and human intelligence that will enable self-deploying sensor networks.
• Initiate Level 1 fusion algorithm and architecture design with associated ontology to manage information from automated sensors to provide a more dynamic and accurate battlespace picture through improved object refinement.

• Complete development technology for improving face recognition technology via enhanced image registration software. (NRL)
• Complete the implementation of a real-time anti-ship missile state assessment capability against modern threats by conducting an empirical performance evaluation and analyze system implications. (NRL) (Previously reported under the Computing and Advanced Sensing activity.)

	FY 2005	FY 2006	FY 2007
KNOWLEDGE SUPERIORITY AND ASSURANCE	16,690	4,575	6,993

KSA explores fundamental technologies that enhance the Navy’s capability to exploit, manage and integrate complex, heterogeneous, multi-source information for the next generation common picture. Science and Technology (S&T) work is being focused on Navy and Marine Corps Warfighter Capability Gaps identified through analysis of operational and exercise lessons learned, as well as campaign analysis of capabilities required in the 2010-2015 time frame.

Currently, small surface, ground and airborne platforms have little to no situation awareness or self-protection, which jeopardizes their effectiveness and survivability. The Electronic Warfare Integrated System for Small Platforms (EWISSP) program focuses on closing that gap by developing Electro-optic/Infrared (EO/IR) technologies to provide them with a full spectrum threat warning and countermeasures capability. This capability, when integrated with future emitter identification and Low Probability of Intercept radar detection systems, will provide netted targeting information and cueing that enables self-protection. (This effort moves to Sea Strike under PE 0602114N in FY 2007.)

There are several FNC efforts that completed in FY 2005 and three efforts transitioning to other PEs in FY 2006. The funding profile from FY 2006 to FY 2007 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. Warfighter Capability Gaps are being addressed by Enabling Capabilities (EC). Each EC delivers capability-level products to acquisition in a three to five-year effort, and allocates a sufficient investment to ensure a capability is provided. ECs addressed include: Next Generation Command, Control and Decision Support Services; Control and Decision Support Services; Combat ID Information Management of Coordinated Electronic Surveillance; Combat ID in the Maritime Domain to Reveal Contact Intent; Automated Control of Large Sensor Networks; as well as Hostile Fire Detection and Response Spiral 1 (in direct support of investments formerly reported under Sea Strike Platform Protection/Electronic Warfare Systems), which, to eliminate redundancy and more accurately describe underlying S&T investments, is included in this activity. This program activity also includes the Reconnaissance, Surveillance and Target Acquisition integrated forecasting and planning tools (previously in PE 0602131M) and the autonomous control of large sensor networks for intelligent autonomous Unmanned Aerial Vehicles (UAV) control program (previously in PE 0602114N).

FY 2005 Accomplishments:

• Continued Environmental Visualization forecasting algorithms to provide information less than an hour old for strike operations as well as Meteorology and Oceanography (METOC) forecasting tool for surface, subsurface, and Special Operations Forces.
• Continued the EWISSP effort by exploration and refinement of the subsystem interface software that will operate via Versa Module Eurocard (VME)-64 and Recommend Standard (RS)-422 buses.
• Completed development of Cryptologic Management and Analysis Support System (CMASS) software to provide a single repository for intercept data, automatic operator alerting, and voice analysis; conducted operational test and transitioned to Ship Signal Exploitation Space, SSES (Increment E) Program Management of Warfare Systems (PMW) 180. Follow-on effort called Processing Tactical Signal Intelligence will begin in FY 2006 under PE 0603235N.
• Completed exploration and refinement of the subsystem interface software for the EWISSP effort.
• Completed the Net Centric Enterprise Services (NCES) work to establish and demonstrate an Extensible Common Operational Picture (XCOP) with data management framework that enabled more rapid and timely technical and developmental exploitation of emerging, complex, and heterogeneous data sources for the Common Picture. Transitioned to Global Command and Control System - Maritime (GCCS-M)(PMW-150).
• Completed refining the Analytic Support Architecture (ASA) that improved location accuracy for air defense threats and transitioned to GCCS-M (PMW-150).
• Completed refining Automated Digital Networking System/Teleport/Global Information Grid-Bandwith Expansion (ADNS/Teleport/GIG-BE) to ensure High Assurance Internet Protocol Encryption (HAIPE) Interoperability and

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

transitioned to PMW 790 shore integration, PMW 160 IA networks and enterprise services, ADNS Increment III, DISA GIG-BE, and Teleport Gen III.
• Completed refining Dynamic Bandwidth Resource Manager and transitioned to C4I & Space SPAWAR PMW-160.
• Completed Rapid Maritime Identification and Tracking System (RMITS) to provide bio-metric identification tools for special operation forces and Naval Boarding parties. Transitioned to Special Operations Mission Planning Office.
• Initiated effort called High Altitude Relay and Router Package to provide wide-band connectivity to tactical units in theater (moves to PE 0603271N in FY 2006).

FY 2006 Plans:

• Continue all efforts of FY 2005, less those noted as completed above.
• Complete Environmental Visualization.
• Initiate the exploration of rapid course of action development using synthetic semi-automated forces for fast, large-scale, and high-fidelity simulations; including models of human cognition and visualization techniques for assessing outcomes and uncertainties.
• Initiate test of the subsystem interface for the EWISSP effort. This effort moves to Sea Strike under PE 0603114N in FY 2007.

FY 2007 Plans:

• Continue all efforts of FY 2006, less those noted as completed above.
• Continue the EWISSP effort: moves to Strike and Littoral Combat Technologies under PE 0602114N in FY 2007.
• Continue effort for Improved Maritime Commercial Operational Tactical Picture in a GIG-ES Environment (previously reported in PE0603235N). This effort provides software to perform level one fusion of intelligence sources and tactical organic sensors to provide knowledge about battlespace objects including location, track, and Combat Identification.
• Continue developing and testing airborne and shipboard battle manager platforms for UAVs operating from Littoral Combat Ships. Continue developing and begin testing an open architecture airborne control station that can be used onboard a P-3 type aircraft for the control of multiple UAVs (Previously reported in PE 0602114N).
• Complete development of multi-vehicle cooperation technologies.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

• Complete medium-fidelity simulation of multi-vehicle cooperation technologies for multiple classes of Naval unmanned vehicles in littoral Intelligence Surveillance and Reconnaissance (ISR) (Previously reported in PE 0602114N).
• Initiate design of tools enabling mission-specific tactical sensor fields for at least two separate mission areas.
• Initiate design of tactical distributed data analysis and automated indications and warnings for 50% of tactical data.
• Initiate design of automated tactical platform and sensor planning and management sufficient for one operator to control of multiple sensors.
• Initiate development of object-level data fusion algorithms to improve maritime common operational picture development in a service oriented architecture environment.
• Initiate Joint Director of Laboratories Data Fusion Model Level 2/3 data fusion research exploring techniques using Bayesian networks, Dempster–Schafer Evidential Reasoning and other techniques for analyzing operational data in establishing routine behaviors & dependencies based on multi-INT fusion and anomaly recognition that indicates hostile intent in the maritime/littoral domain.
• Initiate investigation of smart tactical sensors, platforms, and algorithms in an urban/cluttered environment for at least 2 sensing modalities.
• Initiate investigation of human to tactical sensor field interface to enable the user to locate relevant knowledge within 3 minutes.
• Initiate investigation of local tactical net and Distributed Common Ground Station information interfaces to achieve Level 1 integration.
• Initiate the all-source track and identity fusion effort integrating a broad range of intelligence product information including: Kinematic Radar Reports, Organic and UAV imagery, electronic and communications emissions and human spot reports for tactical and organic sensors to be augmented with national sensors.

	FY 2005	FY 2006	FY 2007
COMMUNICATION AND NETWORKS	11,315	10,990	11,955

This initiative develops wireless communications network technologies critical to the performance and robustness of naval communications for air, ship, submarine, and land platforms. Developments include bandwidth efficient communication techniques; advanced networking techniques for robust, highly dynamic environments; interoperable wireless networks for secure communications and protocols; bandwidth and network management techniques that can effectively manage and allocate bandwidth across tactical and theater levels in support of wireless network centric operations. The exploration payoffs include increased network data rates,

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

improved coalition interoperability, dynamic bandwidth management, greater mobile network connectivity, and efficient waveforms to improve communications with land forces.

FY 2005 and out reflects the realignment of efforts previously reported under the Computing and Advanced Sensing activity. The increase from FY 2006 to FY 2007 is due to increased emphasis in wireless communications.

FY 2005 Accomplishments:

• Continued the development of a high efficiency communications transmitter. Enhanced efficiency with commercial filters and switches will be demonstrated.
• Continued development of nonlinear adaptive equalizer for Ultra-High Frequency (UHF) submarine communications. Began tests to provide a proof of concept that will be tested at sea.
• Continued the development of a Very High Frequency (VHF)/UHF Power Amplifier (PA). Demonstrated that a significant reduction in size, weight, and waste power can be achieved.
• Continued development of the 802.11s standard that will specify a complete Enhanced Service Set Mesh architecture, including auto configuration, dynamic broadcast/multicast/unicast routing, end user mobility, security, and integration with other 802 Local Area Network.
• Completed the Joint Tactical Radio System (JTRS) Maritime Spectrum Awareness and Spectrum Adaptive Polyphase Waveform by finalizing development of Digital Signal Processing algorithms and transitioning these algorithms to programmable JTRS platforms.
• Completed the study of Next Generation Tactical Internet Protocol (IP) networks. Prototyped and tested a number of protocols within the established test beds, updated transition papers, and continued Internet standards development and commercial interaction.
• Completed the peak-to-average ratio improvements for orthogonal frequency division multiplexed (OFDM) signaling with constant envelope.
• Completed work on Interoperable Networks for Secure Communications (INSC) Phase II that will permit transition of INSC technologies into Navy Automated Digital Networking System (ADNS) by FY 2006. Completed initial research and demonstrated a number of IPv6 and IPv4 mobile networking technologies within the coalition architecture.
• Initiated project to mature the superconducting cross-correlator to technology readiness level 6 to enable the development of a multi-function multi-net digital-Radio Frequency dehopping receiver for Link-16. This involves the integration of High Temperature Superconductors analog and Low Temperature Superconductors digital circuits in a COTS two-stage cryocooler.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

• Initiated optical receiver design using avalanche photo-diodes and array-detection techniques for laser communications over the sea in poor weather.
• Initiated research and development into multiple-in-multiple-out (MIMO) antenna technology and OFDM signaling to improve data throughput (500 Mbps) in strong multipath environment.

• Completed demonstration of robotic space rendezvous using real time range imaging and target tracking in the Naval Research Laboratory's Space Robotics Laboratory. (NRL)
• Completed research to improve tactical networks via the development of models, analysis methodologies, and simulation tools. (NRL)
• Completed development of signal processing techniques for digital Electronic Support Measures receivers to detect and identify advanced radar and communication modulations in the presence of non-Gaussian interference sources. (NRL) (Previously reported under Computing and Advanced Sensing activity.)
• Continued development of technology to improve mobile, ad hoc networks (MANET) via multi-agent programs. (NRL)
• Continued research and demonstrations of modulated near-infrared (IR) optical retroreflector data to develop spacecraft to spacecraft data exchange techniques. (NRL) (Previously reported under Computing and Advanced Sensing activity.)
• Continued development of Specific Emitter Identification (SEI) algorithms for communications signals by conducting lab tests and investigating combinations of precision classical parametric measurements and SEI techniques. (NRL) (Previously reported under Computing and Advanced Sensing activity.)
• Continued construction and characterization of spectrally clean, out-phased high-power transmitter using X-band monolithic microwave integrated circuit (MMIC) technology, developing Continuous Wave (CW) radar receiver technology implementing wideband 500-MHz linear chirp at the X-band transmitter, and Ballistic Missile Defense (BMD) discrimination by performing experiments to study micro-Doppler signatures from BMD targets that undergo micro-motions. (NRL) (Previously reported under Computing and Advanced Sensing activity.)
• Initiated the design, fabrication and testing of adaptive radio frequency (RF) elements for autonomous systems to increase the RF performance of small stationary autonomous systems. (NRL) (Previously reported under Computing and Advanced Sensing activity.)
• Initiated development of a concept for recovering Global Positioning Systems (GPS) signals in a "friendly" jamming environment thus allowing GPS to be used while denying that capability to an adversary. (NRL)
• Initiated development of technologies in support of responsive micro-satellites including high speed W-band communications, compact deployable structures, and small, xenon electric propulsion systems. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

FY 2006 Plans:

• Continue all efforts of FY 2005, less those noted as completed above.
• Complete and provide a proof of concept, tested at sea, for the nonlinear adaptive equalizer for UHF submarine communications, mitigating multi-path and narrow band interference. Transition to fleet by Digital Signaling Process software upgrades in submarine UHF receivers.
• Complete the development of an efficient VHF/UHF power amplifier using non-linear components. Transition this effort to the JTRS program.
• Complete the development of a high efficiency communications transmitter based on delta-sigma modulation. Investigate transition path to deployment, including manufacture.
• Complete the development of the 802.11s standard.
• Complete the prototype lab models for MIMO and OFDM signaling.

• Complete efforts on independent high-power radar operation, CW radar receiver technology, and BMD discrimination. (NRL)
• Initiate development of technology to improve tactical network Satellite Communication linkage and multi-user detection. (NRL)
• Initiate development of an adaptive rate terminal to maintain laser communications in poor weather conditions.
• Initiate the development of free space hybrid Infrared laser communications links with greater than 10X bandwidth of digital link for same power. (NRL)

FY 2007 Plans:

• Continue all efforts of FY 2006, less those noted as completed above.
• Complete the cryogenic packaging, test and demonstrate direct digital dehopping of multiple Link-16 waveforms. Establish transition path to JTRS-compliant communications.
• Complete the development of an adaptive rate terminal to maintain laser communications in poor weather conditions. Test the system at NRL’s 32 km maritime Chesapeake Bay test bed. Establish transition path to fleet deployment.
• Complete research and development in MIMO antenna technology and OFDM signaling to improve data throughput (500 Mbps) in strong multipath environments. Finish prototyping of lab models. Finish demo in urban environment. Explore possible transition to United States Marine Corps and/or JTRS.
• Initiate development of high data rate communications (> 1 Gbps data links) for small UAVs, meeting the

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

size, weight and power requirements.
• Initiate development of Robust Airborne Networking Extensions (RANGE) for joint battlespace networking, networking Unmanned Aerial Vehicles (UAV), and hybrid mobile ad hoc networking (MANET)/satellite operation. Implement MANET and MTR protocols for cross-layer optimization, including disruption tolerant networking to sensors and platforms.
• Initiate development of an ultra-wide band (UWB) groundwave communication for a distributed sensor network (buoy).

• Complete development of technology to improve mobile, ad hoc networks via multi-agent programs. (NRL)
• Complete communications SEI by transitioning best approaches into operational Navy electronic support and electronic attack systems. (NRL)
• Complete the design, fabrication and testing of the phased array RF elements for autonomous systems with the fabrication of a prototype unmanned system. (NRL)
• Initiate development of technologies in support of responsive micro-satellites including laboratory demonstrations of optimized xenon electric propulsion system and deployable structures. (NRL)
• Initiate development of a broadband electronically-steerable array for mission security (BEAMS) based on Rotman microwave lens beam forming/steering techniques and apply to small UAV directional communications.
• Initiate expanded study of “friendly” GPS jamming techniques to include those designed specifically to minimize fratricide while maintaining effectiveness of jamming against threat GPS receivers (NRL)
• Initiate development of advanced free space communications to include performance tests in marine environments. (NRL)

	FY 2005	FY 2006	FY 2007
MULTI-SOURCE INTEGRATION AND COMBAT IDENTIFICATION	6,775	8,690	12,090

This activity addresses theater air and missile defense (TAMD) needs for rapid, high confidence Combat Identification (CID) of air and missile threats at long range using real time and non-real time threat attributes and intelligence information. This activity supports the Sea Shield Pillar Enabling Capability of Real Time Long Range Air Defense CID in Support of Early Engagements and related CID Science & Technology to be worked under the FORCEnet FNC.

The Multi-Source Integration effort, Composite Combat Identification, and Advance Sensor Netting Technology efforts complete in FY 2007. The funding increase from FY 2006 to FY 2007 is to complete the technology/algorithm development of these efforts.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

FY 2005 Accomplishments:

• Continued laboratory demonstrations of ASNT and CCID.
• Continued MSI project development and testing of algorithms to integrate real time and non-real time sensor data and correlate satellite communications (SATCOM) data in the E-2C aircraft mission computer.
• Continued development of ASNT algorithms for integration of electronic warfare support (ES) data into the Open Architecture Track Manager in future combat systems and transmission of track ID attributes via real time sensor networks.
• Continued development of CCID algorithms to correlate and fuse real time tracks with intelligence, surveillance, and reconnaissance data in Ship Signal Exploitation Equipment (SSEE) equipped surface ships and common reasoning algorithms for CID capability to rapidly build high confidence identification of air tracks using all available ID attributes in theater.

FY 2006 Plans:

• Continue all efforts of FY 2005.

FY 2007 Plans:

• Complete ASNT, CCID, and MSI development. MSI, ASNT, and CCID will transition to the E-2C/D Program Management Office (PMA-231), Intelligence, Surveillance, Reconnaissance, and Information Operations Program Office (PMW-180), and Program Executive Office-Integrated Warfare Systems (PEO-IWS).

	FY 2005	FY 2006	FY 2007
HUMAN FACTORS AND ORGANIZATIONAL DESIGN	4,500	5,410	6,178

This activity (formerly Human Computer Interface) focuses on improving platform, task force, and battle group operations by developing decision support technology for incorporation into operational systems. The goals are to enhance human performance effectiveness; improve decision support and decision-making collaboration; improve human-centered design; and accelerate insertion of advanced human factors engineering technology into existing and new weapons systems. The payoff is the creation of decision-action cycles that are faster than an enemy’s, and reduced workload and staffing requirements. Specific objectives include achieving improved situational awareness and speed of command through a deeper understanding of human capabilities and

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

limitations; as well as accomplishing quality performance in complex, dynamic, high-tempo, and uncertain threat environments. These objectives are being pursued in three focus areas: Decision Support and Organizational Design, Collaboration and Knowledge Management, and Human-Computer Interaction/Visualization.

The funding profile increases from FY 2005 due to additional emphasis and expansion of the exploration of cognitive modeling and exploration of Human-Computer Interfaces to large complex data sets including the GWOT.

FY 2005 Accomplishments:

• Initiated evaluation of Latent Semantic Analysis of operator communications as an effective metric of shared situational awareness in unmanned aerial vehicle control teams.
• Initiated demonstration of Electronic Card Wall (EWALL) (a computational human cognitive processing system) for representation and transfer of meaning among heterogeneous and distributed team members engaged in complex problem solving.
• Initiated developing jointly with the Naval Air Systems Command, a FORCEnet-based test bed to identify and evaluate the cognitive processes to be employed to optimize collaborative decision-making in a geographically distributed and time-delayed situation.
• Initiated model-based simulations and experiments to investigate the effectiveness of heterarchical organizational structures in network-centric operational environments in order to evaluate the implementation of FORCEnet concepts.
• Initiated development of new threat scenarios incorporating Joint Force Maritime Component Commander operations, counter-insurgency and humanitarian operations with the staff of the Naval War College. These new threat scenarios will provide the basis for Limited Objective Experiments in the Innovation Laboratory at the Naval War College.
• Initiated development of Dynamic Network analysis (a terrorist network analysis tool) in operational command setting at U.S. Pacific Command.
• Initiated the improvement of terror network analysis decision tools for combatant command use and military planning, including testing of tools, development of metrics, and validation.
• Initiated development of a user tool to counteract perceptual errors associated with 3D perspective-view visual displays.
• Initiated evaluation of the effectiveness of a change history tool to minimize the effect of interruptions.
• Initiated application of cognitive architecture modeling to the design of interface analysis tools.
• Initiated deployment of models for Effects-Based Operations (EBO) aboard naval vessels to support Expeditionary Group One to conduct kinetic and non-kinetic tactical operations in a measured manner.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

• Initiated development of a cognitive model of human performance with 3D audio displays.
• Initiated development of technology to improve voice biometrics via the development of multi-dimensional, adaptive speaker verification technology. (NRL) (Previously reported under the Computing and Advanced Sensing activity.)

FY 2006 Plans:

• Continue all efforts of FY 2005.
• Initiate jointly with the Air Force applied research on the integration of Information Operations in Air Control Centers.
• Initiate applied research on command and control adaptive architectures for Expeditionary Strike Groups working with OPNAV N-75B and Expeditionary Strike Group ONE, San Diego.

FY 2007 Plans:

• Continue all efforts of FY 2006.
• Initiate the development of advanced computational models capable of analyzing multi-dimensional networks of thousands of nodes. Current capabilities enable the analysis of networks consisting of hundred of nodes.
• Initiate the development of computational models of influence that incorporate the social structure, values and cultural processes of urban non-western communities for achieving post-conflict stabilization.
• Improve response speed of the LSA tool to a near-interactive level and incorporate into a fleet experiment. Collect and evaluate data to validate improved speed and effectiveness of developing situational awareness.
• Incorporate the EWALL prototype into the Tactical Operations Center of the Special Operations Forces and collect performance data to validate effectiveness.
• Initiate Sea Basing research on rehearsal for Expeditionary Strike Groups in the conduct of maritime interdiction missions and developing reach-back capability for computationally intense analysis for evaluating courses of action.

• Complete development of technology to improve voice biometrics via the development of multi-dimensional, adaptive speaker verification technology. (NRL) (Previously reported under the Computing and Advanced Sensing activity.)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

	FY 2005	FY 2006	FY 2007
TACTICAL SPACE EXPLOITATION	0	15,000	14,875

The Tactical Space Exploitation initiative explores the application of new technologies on small, light-weight and low-cost satellites to enhance naval warfighting capabilities; taking advantage of the global access, revisit and connectivity provided by orbital platforms. Initial efforts will be aimed at developing integrated signals electronics packages to test new concepts for global ship tracking and two-way data exfiltration using next-generation Internet Protocol (IP) technology from an array of sea-based and land-based sensors. Advanced multispectral/hyperspectral electro-optical sensors will be developed to demonstrate new warfighting constructs.

This effort begins in FY 2006.

FY 2006 Plans:

• Initiate development of integration plans, algorithms, and satellite concept of operations to demonstrate the integrated signals payload as a secondary payload on an FY 2007 small satellite launch.
• Initiate development of small multifunctional integrated signals electronics systems for ship tracking from space and two-way data exfiltration from distributed global sensors.
• Initiate development of a satellite-borne electro-optical sensor system for FY 2008 launch on a small satellite to test new techniques for surveillance of environments and targets of naval interest for anti-submarine warfare and mine warfare.
• Initiate and complete system designs including configuration of satellite hardware electronics to enable procurement of flight parts.
• Initiate preliminary environmental and flight testing of hardware components.

FY 2007 Plans:

• Continue all efforts of FY 2006.
• Complete preliminary environmental and flight testing of hardware components.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
AIREP (FORMERLY UESA)	11,186	5,550

FY 2005: This effort developed the track adaptive processor, an Identification Friend or Foe (IFF) capability for circular arrays and a data collection capability and modifyed the radar for wideband capability.

FY 2006: This effort supports Advanced Integrated Radar Electronics and Photonics (AIREP) research.

	FY 2005	FY 2006
COMMON SENSOR MODULE (COSM)	1,737	0

Conducted field demonstrations with existing electro-magnetic sensor and upgraded classification algorithm based on neural nets to identify vehicles based on electro-magnetic emissions. Expanded library of signatures to include almost two-dozen commercial and military vehicles.

	FY 2005	FY 2006
COORDINATED OPERATION OF UNMANNED VEHICLE FOR LITTORAL WATERS	0	2,600

This effort supports coordinated operation of unmanned vehicle for littoral waters research.

	FY 2005	FY 2006
CRITICAL AREA PROTECTION SYSTEMS HIGH RESOLUTION SITUATIONAL AWARENESS	0	1,500

This effort supports critical area protection systems high resolution situational awareness research.

	FY 2005	FY 2006
EXPEDITIONARY WARFARE TESTBED GLOBAL INFORMATION GRID ENTERPRISE SERVICES	0	1,000

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

This effort supports expeditionary warfare testbed global information grid enterprise services research.

	FY 2005	FY 2006
M2C2	5,787	6,500

FY 2005: This effort developed an early entry command, control, and communications payload, with associated technologies, suitable for future insertion into the Marine Corps to-be-selected internally transportable (in the MV-22) vehicle. It provided on-the-move, over-the-horizon connectivity with limited terrestrial communications and command and control capabilities for the local on-site commander.

FY 2006: This effort supports Mobile Modular Command and Control(M2C2) research.

	FY 2005	FY 2006
NAIF	5,787	5,100

FY 2005: The Network Applications Integration Facility (NAIF) served as an exercise center for the Third and Seventh Fleet demonstrations and for the development of Tactical Component Network interfaces with systems such as the Advanced Digital Network System. NAIF developed Hawaiian tech base development through participation of Hawaiian technology firms in Navy's program interface development for use in the Tactical Component Network.

FY 2006: This effort supports Network Applications Integration Facility (NSIF) research.

	FY 2005	FY 2006
NATIONAL CENTER FOR ADVANCED SECURE SYSTEMS RESEARCH (NCASSR)	4,822	0

Funding addressed continuing advancements in comprehensive vulnerability analysis and the development of tamper-resistant hardware and software.

	FY 2005	FY 2006
PACIFIC THEATER DATA FUSION TESTBED	0	1,700

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

This effort supports pacific theater data fusion testbed research.

	FY 2005	FY 2006
RADIO SENSOR MODULE (RASM)	0	1,200

This effort supports radio sensor module research.

	FY 2005	FY 2006
SEADEEP	2,412	0

Funds supported technologies to demonstrate a two-way sensor data link for high data rate, low probability of intercept, communications between airborne platforms and submerged submarines. Demonstrated the use of a steerable Micro-electro Machine System to steer a laser beam in a small unmanned vehicle.

	FY 2005	FY 2006
SENSORNET	0	17,500

This effort supports sensornet research.

	FY 2005	FY 2006
TESTING, EVALUATION AND DEMONSTRATION OF WEBSTER	1,446	0

Webster, web-based information fusion system for counter-terrorism operations (CTO), explicitly accounted for uncertainty in data. It used data from multiple existing INTEL and open source systems (especially the World Wide Web (WWW)) to produce a high-level information system that specifically quantifies data certainty and source reliability. Webster modeled each step of the normal intelligence analytical process (collect, fuse, analyze, report, and disseminate) and attempts to estimate uncertainty that arises along the way. Accelerated development and testing of Webster to support operational needs.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

	FY 2005	FY 2006
THEATER UNDERSEA WARFARE INITIATIVE	7,330	6,000

FY 2005: This effort developed Theater Under Sea Warfare (TUSW) Program tools with the addition of operations rehearsal simulations, enhancements to the Asset Allocation Tool (AAT), evaluation of TUSW tools in Undersea Warfare exercises and the study of composable FORCENet integration, automated extraction of asset status and Commercial Joint Mapping Took Kit (CJMTK) cartography benefits.

FY 2006: This effort supports theater undersea warfare research.

	FY 2005	FY 2006
WEB-BASED TECHNOLOGY INSERTION	963	0

This effort took emerging web based solutions and applied them to an area such as time critical targeting and expeditionary warfare applications, and determined the effectiveness of using enterprise solutions to provide a universal operator interface and to allow interoperability with existing systems. Upgraded capabilities to automate discovery and access functions to lower operator workload. Tested to determine suitability of new tools.

	FY 2005	FY 2006
WEBSTER INTEGRATION	0	1,000

This effort supports webster integration research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:

PE 0601153N (Defense Research Sciences)
PE 0602114N (Power Projection Applied Research)
PE 0602123N (Force Protection Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602236N (Warfighter Sustainment Applied Research)
PE 0602271N (RF Systems Applied Research)
PE 0603114N (Power Projection Advanced Technology)
PE 0603123N (Force Protection Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0603236N (Warfighter Sustainment Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603609N (Conventional Munitions)
PE 0603658N (Cooperative Engagement)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))
PE 0603727N (Navy Technical Information Presentation System)
PE 0604307N (Surface Combatant Combat System Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0206313M (Marine Corps Communications Systems)

NON-NAVY RELATED RDT&E:

PE 0602204F (Aerospace Sensors)
PE 0602702F (Command Control and Communications)
PE 0602782A (Command, Control, Communications Technology)

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
WARFIGHTER SUSTAINMENT APPLIED RESEARCH	118,949	110,056	89,964	77,398	82,173	79,727	83,946

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This PE supports the Future Naval Capabilities (FNCs) of Expeditionary Logistics, Littoral Combat/Power Projection, and Total Ownership Cost (TOC) Reduction; and innovation-based efforts that will provide technology options for future Navy and Marine Corps capabilities. Efforts focus on manpower and personnel; naval systems training; expeditionary logistics; littoral combat and power projection capabilities; advanced naval materials; medical technologies; environmental quality; biocentric technologies; high speed sealift; cost reduction technologies; and seabasing technologies. Within the Naval Transformation Roadmap, this investment supports eight transformational capabilities within the "Sea Strike", "Sea Shield", and "Sea Basing" operational concepts; the critical human system, "Sea Warrior"; and Naval business efficiencies within "Sea Enterprise."

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	131,030	82,856	97,000
Congressional Action	0	28,450	0
Congressional Undistributed Reductions/Rescissions	-101	-1,250	0
Execution Adjustments	-9,649	0	0
FY 2005 SBIR	-2,333	0	0
Program Adjustments	2	0	-5,069
Program Realignment	0	0	-2,335
Rate Adjustments	0	0	368
FY 2007 President's Budget Submission	118,949	110,056	89,964

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
As discussed in Section A, there are a significant number of varied efforts within this PE. For the most part these efforts support the Future Naval Capabilities (FNC) program of the Office of Naval Research. As such, each is monitored at two levels. At the lowest level each is measured against both technical and financial milestones on a monthly basis. Annually each FNC and its projects are reviewed in depth for technical and transition performance by the Chief of Naval Research against goals which have been approved by the Navy’s senior flag level Technical Oversight Group.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

The FNC managers conduct routine site visits to performing organizations to assess programmatic and technical progress and most projects conduct an annual or bi-annual review by an independent board of visitors who assess the level and quality of the Science and Technology (S&T) basis for the project.

Additionally, most of these projects support specific Defense Technology Objectives (DTO) established by the Director, Defense Research and Engineering (DDR&E). These receive a bi-annual technical and programmatic review under the Technology Area Review Assessment program conducted by DDR&E.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
WARFIGHTER SUSTAINMENT APPLIED RESEARCH	52,621	71,106	89,964	77,398	82,173	79,727	83,946

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project supports the Future Naval Capabilities (FNCs) of Expeditionary Logistics, Littoral Combat/Power Projection, and Total Ownership Cost (TOC) Reduction; and innovation-based efforts that will provide technology options for future Navy and Marine Corps capabilities. Efforts focus on manpower and personnel; naval systems training; expeditionary logistics; littoral combat and power projection capabilities; advanced naval materials; medical technologies; environmental quality; biocentric technologies; high speed sealift; cost reduction technologies; and Sea Basing technologies. Within the Naval Transformation Roadmap, this investment supports eight transformational capabilities within the "Sea Strike", "Sea Shield", and "Sea Basing" operational concepts; the critical human system, "Sea Warrior"; and Naval business efficiencies within "Sea Enterprise."

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
MANPOWER/PERSONNEL	2,273	2,247	2,435

These technologies enhance the Navy's ability to select, assign, and manage its people by responding to a variety of requirements, including: managing the force efficiently and maintaining readiness with fewer people and smaller budgets; providing warfighting capabilities optimized for low-intensity conflict and littoral warfare; and operating and maintaining increasingly sophisticated weapons systems while managing individual workload and supporting optimal manning.

The increase in funding from FY 2006 to FY 2007 is due to integration of products that complete in FY 2007.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2005 Accomplishments:

- Completed Cognitive Agents Technologies reliability testing and optimization of member/command agents.
- Completed Land Attack Training Tool analysis and design.
- Completed delivery of optimized microfluidic components for miniaturizing and automating medical diagnostic procedures for personnel protection. (NRL)
- Initiated applicant cultures and values program to test the practicality and predictive validity of socialization measures for selection into the military.
- Initiated modeling integration of forecasting/trend analysis models across the personnel enterprise.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete modeling of forecasting/trend analysis models within functions of the personnel enterprise.
- Initiate modeling integration methodologies for sailor/marine members’ cognitive agents and distribution and assignment system portal.
- Initiate low-velocity impact and shaker table dynamic internal response mapping with new anatomical features and sensor suite GelMan thoracic surrogate. (NRL)

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete applicant cultures and values program to assess the practicality and predictive validity of socialization measures for selection into the military.
- Complete modeling integration methodologies for sailor/marine members’ cognitive agents and distribution and assignment system portal.

	FY 2005	FY 2006	FY 2007
TRAINING TECHNOLOGIES	8,703	9,428	14,491

Training technologies enhance the Navy's ability to train effectively and affordably in classroom settings, in simulated environments, and while deployed, and to operate effectively in the complex, high-stress, information-rich and ambiguous environments of modern warfare. Technology development responds to a variety of requirements, including providing more affordable approaches to training and skill maintenance.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

The increase in funding from FY 2005 to FY 2006 is due to rebalancing of funds and intiation of planned projects. The increase from FY 2006 to FY 2007 is due to work necessary to successfully complete research efforts that were delayed in FY 2006.

FY 2005 Accomplishments:

- Continued development of optimized strategies for performance aiding and training.
- Continued training aid research for Close Quarters Battle (team training), immersive interaction applications, and Computer Generated Forces (CGF) for improving training effectiveness in Virtual Environments.
- Continued task to develop multi-agent based architectures for modeling human behavior.
- Continued program on intelligent agents for objective-based training.
- Continued CGF task aimed at improved techniques for human cognitive and behavioral modeling.
- Continued work on effective feedback in artificially intelligent tutoring for dynamic task environments such as anti-air warfare, instrument flying and other characteristic military tasks.
– Completed task to improve the capability of CGF as instructional agents.
- Completed physics tutor project, including associated studies of tutoring strategies.
- Completed development of measures to link shared cognition with team performance.
- Completed research to support students (of intelligence analysis) in becoming independent users of broad-based information.
- Initiated a systematic program of applied research addressing unanswered questions regarding effective instructional strategies in artificially intelligent tutoring.
- Initiated work on software tools to facilitate building natural language tutorial dialogs for artificially intelligent tutoring.
- Initiated task to apply recently developed learning techniques that can be used in a model interacting with its application environment to extend or refine its knowledge base and behavioral competence.
- Initiated and completed development of user design guidelines related to mobile computing for maintenance and report detailing hardware tools to support mobile maintenance.
- Initiated and completed development of Super Manual related tools and interim report on Super Manual progress and testing results.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2006 Plans:

- Continue development of immersive interaction technologies for team training application
- Continue research in Computer Generated Forces (CGF) for improving training effectiveness in Virtual Environments.
- Continue task to develop multi-agent based architectures for modeling human behavior, improve techniques for human cognitive and behavioral modeling, and create highly realistic simulated teammates.
- Complete training aid research for Close Quarters Battle (team training).
- Complete program in intelligent agents for objective-based training
- Initiate field studies and user tests evaluating new features and job aiding tools.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete development of optimized strategies for performance aiding and training.
- Complete development of immersive interaction technologies for team training application
- Complete research in Computer Generated Forces (CGF) for improving training effectiveness in Virtual Environments.
- Complete task to develop multi-agent based architectures for modeling human behavior, improve techniques for human cognitive and behavioral modeling, and create highly realistic simulated teammates.
- Complete modeling of the integration of different military domains into a distributed Virtual Technologies and Environments Full Spectrum Combat simulation.

	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT / POWER PROJECTION	6,062	10,738	9,977

This activity provides technologies which enhance the ability of the Navy-Marine Corps team to assure access and sustained operations in the littorals. The Littoral Combat/Power Projection FNC considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); fires; maneuver; sustainment; and force protection. This activity includes Urban, Asymmetric Operations-related to FNC Enabling Capabilities, such as advanced fires coordination and interoperability, hostile fire detection/response, and network monitoring, management and secure wireless technology.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2006 funding level reflects the alignment of funding to continue and complete FNC efforts previously funded in other PEs.

FY 2005 Accomplishments:

- Continued efforts for laser safety testing of Streak Tube Imaging Light Detection and Ranging (LIDAR) technology being developed as part of the obstacle avoidance system for the Expeditionary Fighting Vehicle (EFV). (FY 05 funded by PE 0602131M)
- Continued development of advanced weapons materials technology for use in artillery and mortar systems. (Concurrently funded by PE 0602131M).
- Continued development of Organic Light Emitting Diode (OLED) display technology for shipboard and Marine use. (Previous effort funded by PE 0602131M; concurrent effort funded by PE 0602782N; FY 2006 funding by PE 0602782N)
- Initiated development of improved lightweight fire control systems interface technologies.
- Initiated development of landmine countermeasure insensitive munitions technology. (Concurrent effort funded by PE 0602131M)
- Initiated program to develop oxygen, water vapor and temperature measurement capability for safety during littoral combat (NRL).

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Continue development of advanced weapons materials technology for use in artillery and mortar systems. (FY 2007 effort funded by PE 0602131M)
- Continue development of light weight fire control systems interface technologies. (FY 2007 effort funded by PE 0603640M)
- Continue development of advanced fires coordination and interoperability to enable MAGTF/Joint fires. (Previous effort funded by PE 0602131M)
- Continue development of network monitoring and management tools technology. (Previous efforts funded by PE 0602131M)
- Continue development of secure mobile network/secure wireless LAN technology. (Previous efforts funded by PE 0602131M)
- Complete development and transition innovative relays Beyond-Line-of-Sight (BLOS) in the areas of wideband

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

communications and advanced modular systems. (Previous efforts funded by PE 0602131M)

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Continue development of hostile fire detection and counterfire technology (Gunslinger). (Previous efforts funded by PE 0602131M)
- Initiate development of advanced naval fires technology spiral 1.
- Initiate development of improvised explosive device (IED) mitigation technology spiral 2.

	FY 2005	FY 2006	FY 2007
ADVANCED NAVAL MATERIALS	6,983	11,693	7,237

Advanced Naval Materials efforts include: advanced, high-performance materials; processes to reduce weight and cost; and enhanced sonar transducers.

FY 2005 Accomplishments:

– Continued development of ultra light, blast resistant composite structural materials.
– Continued low cost phthalonitrile based organic resin material and hybrid composite development with improved fire resistance; and process development of fiber reinforced foam material.
- Continued development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines.
– Continued development of friction stir welding of steels; high strength, high toughness, affordable ship steels for weight reduction; weld processing of stainless steel; and improved welding consumables for affordable construction of reduced weight, survivable ships.
– Continued development of multifunctional transducer material, high-force high-strain actuators; and evaluation of advanced transducer single crystal high strain materials.
– Continued multi-laser-processing technique development for the fabrication of ultra hard materials for wear resistance applications.
- Continued development of advanced, cost-efficient joining of titanium for >25% weight reduction of large seaborne structures.
- Continued development of advanced composites and polymers with fire resistance for ship structures

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

– Continued development of nanotube reinforced composite materials for the improvement of their out-of-plane mechanical properties.
– Continued development of acceptance testing methodologies for advanced transducer single-crystal high-strain materials and definition of standardized materials properties and composition ranges.
– Continued fabrication studies of pultruded sandwich structures for low cost ship structural applications.
– Completed development of modeling and process control for reduced weld distortion and residual stresses.
– Completed development of weld processing of stainless steel for non-magnetic, damage tolerant ships.
– Completed development of multifunctional transducer materials.
– Completed development of phthalonitrile based organic resin material and hybrid composite with improved fire resistance.
- Initiated friction stir welding development for control of residual stresses and elimination of distortion in naval steels.
– Initiated development of cellular metal blast resistant panels.
– Initiated development of cellular metal ballistic armor.
- Initiated development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications.
– Initiated development of cavitation resistant ship rudder coatings based on FY 2004 shipboard coating study.
- Initiated catalyst development and grew vertically aligned carbon nanotubes in existing gated silicon post structures in a DC plasma CVD reactor, obtaining stable field emission and 1 ampere/cm2 current densities. (NRL)
- Initiated program to optimize a-c loss and mechanical reliability of second generation high temperature superconductors for future naval power applications. (NRL)

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Initiate marine titanium alloy design and development, exploiting anticipated cost reductions for high performance, reduced maintenance naval applications.
- Initiate development of continuous single wall carbon nanotube composite materials for next generation air and naval platforms.

FY 2007 Plans:

- Continue all efforts of FY 2006.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

– Complete development of high-force, high-strain actuators.
– Complete fabrication studies of pultruded sandwich for low cost, high performance ship structural applications.
– Complete cellular metal blast resistant materials with full section ship hull blast evaluation.
– Initiate development of innovative sonar transducers based on high-strain, high-coupling piezoelectric single crystals.
– Initiate development of integrated structural composites with blast resistance, manufacturing technologies, and low-cost organic resins with improved fire resistance.
- Initiate development of novel processing technologies for increasing the fatigue strength and corrosion resistance of weldments for ship structures with reduced weight and maintenance requirements.
- Initiate development of solid-state growth methods for making high-strain, high-coupling piezoelectric single crystals.

	FY 2005	FY 2006	FY 2007
MEDICAL TECHNOLOGIES	10,483	7,867	9,991

This program supports the development of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care, or the logistics of providing self/buddy-carried, life saving technologies for massive battlefield wounds. The National Institutes of Health (NIH) focuses on the basic science of disease processes, not applied research related to development. Programs are complementary with those of the Army and are coordinated through the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee to prevent duplication of effort. This project funds the Force Health Protection Future Capability (FHPFC) Program (formerly titled Warfighter Protection Future Naval Capability) and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike".

FY 2005 Accomplishments:

- Continued developing tests for confirmation of vaccination and diagnosis of diseases and toxin exposure.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

Goal is to create noninvasive tests that produce results in minutes, not hours or days.
- Continued work on shipboard injury, exposure guidelines, and engineering specifications for preventing shock-related injury. Reducing neck, spine and musculoskeletal injury will increase force readiness.
- Continued work on hearing protection systems and on improved treatment for restoring Noise-Induced Hearing Loss (NIHL). Compensation for hearing loss currently costs DoN over $70M per year.
- Continued studies on decompression sickness, to include novel approaches to the prevention, detection and treatment of decompression sickness, particularly by non-recompressive methods.
- Continued efforts to develop prophylactic agents preventing hyperbaric oxygen toxicity. Prolonged exposure to hyperbaric oxygen can be toxic to lungs, nervous system and eyes.
- Continued work on predictive measures for oxygen-induced seizures in Navy and Marine Corps divers. Real-time prediction of hyperbaric oxygen-induced seizures will improve operational capability.
- Continued efforts to assess the impact of thermal (i.e., heat and cold) stress on operational performance. Underwater thermal extremes can affect diver performance and alter risk of incurring decompression sickness.
- Completed study of drugs and devices for uncontrolled hemorrhage.
- Completed characterization of therapeutics to protect against hemorrhagic shock. Such protection would reduce the need for resuscitative fluids and relieve the logistical burden for Naval forces.
- Completed study of analgesics without adverse effects.
- Completed efforts on resuscitative fluids to increase cardiovascular function and tissue perfusion in combat casualties.
- Completed applied research into medical devices for casualty monitoring.
- Completed validation of microbial array at the Centers for Disease Control and transition to an advanced concept technology demonstration (NRL).
- Initiated study to characterize therapeutic interventions in wound management. Focus is to reduce morbidity resulting in a quicker return to duty and a reduction in medical resource requirements.
- Initiated studies related to optimization of diver performance. Operational performance in the undersea environment can be hampered by a variety of environmental stressors.
- Initiated research to treat and prevent attrition due to combat related psychological stress and acute Post-Traumatic Stress Disorder (PTSD).

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete work on predictive measures for oxygen-induced seizures in Navy and Marine Corps divers.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete studies related to optimization of diver performance.
- Complete work on shipboard injury, exposure guidelines, and engineering specifications for preventing shock-related injury. Reducing neck, spine and musculoskeletal injury will increase force readiness.

	FY 2005	FY 2006	FY 2007
ENVIRONMENTAL QUALITY	2,358	3,213	3,308

Environmental Quality technologies enable sustained world-wide Navy operations in compliance with all local, state, regional, national and international laws, regulations and agreements, and support the Navy Transformational Roadmap in the areas of Sea Basing, Sea Strike and Sea Warrior. Compliant operations enable training evolutions and exercises that are critical for maintaining readiness.

FY 2005 Accomplishments:

- Continued efforts in evaluation of novel membranes, development and testing of environmentally benign marine antifouling (AF) coatings, air and noise pollution abatement technologies, automated underwater hull surface preparation, development and testing of new aqueous film forming foam (AFFF) formulations (without perfluoroctanylsulfonates, PFOS), studies to accurately determine input of copper into harbor environments from Navy ship hull coatings, preliminary studies for development of robotic hull bug technology for prevention of fouling.
- Completed development of non-chlorofluorocarbon/hydrochlorofluorocarbon (CFC/HCFC) cooling methodologies, Navy ship ballast water exchange efficacy evaluation, and feasibility study of bioreactor startup package.
- Completed natural product biofouling repellent synthesis task, completed initial environmental dynamic marine exposure testing for coating, completed coatings formulation task. (NRL)

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete evaluation of porous inserts for noise and air emissions reduction from gas turbine engines and emission control technologies for control of emissions from marine diesels.
– Initiate development of new, advanced, environmentally benign AF/AC coating systems for Navy platforms, far-

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

term noise and air pollution emissions abatement technology for unrestricted operations, and alternative torch technologies for shipboard plasma waste treatment, and multiple aqueous metal ion sensor to incorporate copper sensor developed in SERDP program for planned combined transition to ESTCP.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete evaluation of AFFF without PFOS and studies to determine copper input into harbors from Navy ship hull coatings.
– Initiate development of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems.

	FY 2005	FY 2006	FY 2007
BIOCENTRIC TECHNOLOGIES	0	1,062	1,055

Biocentric technologies provide novel solutions for naval needs based upon the applications of biosensors, biomaterials, and bioprocesses. This program brings the power of modern biotechnology methods to bear on naval problems and reduces the technical risk associated with basic research advances by conducting demo-centric technology development programs. Topic areas include development of acoustic sensors based on biomimetics; microbial engineering to produce high-value naval materials such as energetic compounds, and marine mammal vaccines and immunodiagnostics.

This effort initiates in FY 2006.

FY 2005 Accomplishments:

- Continued small aperture biomimetic bidirectional acoustic sensor effort, but transfer from Code 341 Biocentric Technology (PE 0602236N) to Code 321 Maritime Sensing (PE0602747N) in FY06.
- Continued development of reagentless sensors for weapons of mass destruction/explosives, using engineered protein based sensors for detection of toxins (e.g., ricin, domoic acid) and explosives (e.g., TNT, RDX). (Funded in PE 0602435N in FY05 because of lack of funding in 0602236N; will move to PE 0602123N in FY06 after realignment of activities in PE 0602123N as this presents the best match for this program’s activity)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2006 Plans:

- Continue efforts in marine mammal vaccine and immunobiological diagnostics development (originally funded in FY 2004 in PE 0602123N; Congressional funding used in FY 2005; best suited to 0602236N given scope of work)
- Continue engineered microbial synthesis and processing of energetic materials (moved from PE 0602435N in FY 2006 because of realignment of activities within that PE in FY 2006)
-Initiate development of innovative naval biosensors, biomaterials, and bioprocess technology.

FY 2007 Plans:

- Continue all efforts of FY 2006.
- Continue efforts on marine mammal diagnostics (detection of viruses, fungi and bacteria).
- Continue effort on naval biosensor to detect brain structures and blood vessels through skull bones.

	FY 2005	FY 2006	FY 2007
HIGH SPEED SEALIFT	9,150	10,455	12,474

Fast sealift continues to be a military priority. However, friction drag reduction is increasingly essential for long-range, large-payload Navy ships to travel at high speeds (50+ knots). The High Speed Sealift effort focuses on the design of a hydrodynamic experimentation capability to resolve questions pertaining to full-scale implementation of friction drag reduction procedures.

FY 2005 Accomplishments:

- Initiated procurement of major components required to modify the existing flow facility at the William B. Morgan Large Cavitation Channel (LCC) operated by Naval Surface Warfare Center-Carderock Division in Memphis, Tennessee. These components will be used to provide increased flows and pressures within the LCC to meet the goals of high-speed drag reduction experimentation.
- Initiated development of experimentation test plans, management procedures, and system requirements.
- Initiated high-speed sea lift system studies.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Complete procurement of major components required to modify the existing flow facility (LCC)in Memphis, TN.
- Initiate and complete installation of major components in the LCC.
- Initiate and complete testing and certification of performance.
- Initiate designs for large-scale testing of technologies, concepts, and systems.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete development of experimentation test plans, management procedures, and system requirements.
- Complete high-speed sealift system studies.
- Complete designs for large-scale testing of technologies, concepts, and systems.
- Initiate and complete large-scale assembly and testing of technologies, concepts, and systems.
- Initiate and complete experiments for technologies, concepts and systems.

	FY 2005	FY 2006	FY 2007
COST REDUCTION TECHNOLOGIES	6,609	8,129	10,181

Cost Reduction Technology efforts include: ultrareliable materials and sensors to reduce cost by enabling condition-based and zero maintenance capabilities; and airframe and ship corrosion efforts for advanced cost effective prevention and life cycle management technologies. This activity includes the Navy's share of the Versatile, Affordable, Advanced Turbine Engine (VAATE) program. Investments under this activity were previously reported under Advanced Naval Materials. This new activity breakout provides improved clarification of the overall investment scope.

The increase in funding from FY 2005 to FY 2006 is due to an increased scope of efforts. The increase in funding between FY 2006 and FY 2007 is due to completion of various efforts.

FY 2005 Accomplishments:

- Continued development of durable new materials and thermal barrier coatings for naval gas turbine hot

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

sections; environmental barrier coatings for ceramics/composites for gas turbine engines; new thermal barrier technology; materials and processes for high temperature turbine disks; and higher temperature aluminum alloys for propulsion.
- Continued development of road test methodology and coating test metrics for the USMC vehicles; longer-life, enhanced-performance self-priming topcoat and corrosion preventive compounds (CPC) for aircraft; and spectral imaging/thermography technology.
- Continued the development of single coat corrosion control coatings for fuel tanks.
- Continued the development of single coat corrosion control coatings for collect/hold/transfer (CHT) tanks.
- Continued development of ultrasonic imaging NDI for aircraft.
_ Continued development of magneto resistive NDI for aircraft.
- Completed development of a next generation composite propeller distributed structural health monitoring system.
- Completed longer-life, enhanced-performance, self-priming top coat and CPC.
- Completed the development of single coat corrosion control coatings for potable water tanks.
- Completed development of spectral imaging/thermographic (Nondestructive Inspection) NDI for aircraft.
- Initiated development of ceramic matrix composite turbine blades for gas turbine engines.
- Initiated development of calcium magnesium aluminum-silicate (CMAS) resistant thermal barrier coatings.
- Initiated development of portable, real-time, NDE(non-destructive examination)/NDI technology for heat damage detection in composite materials.
- Initiated development of nickel-aluminized thermal barrier coating which will be phase compatible with turbine blade alloys.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Continue development of cavitation resistant ship rudder coatings transitioned from FY 2005 Advanced Naval Materials.
- Continue NDE/NDI technologies for damage detection in composite materials
- Complete the development of single coat corrosion control coatings for fuel tanks.
- Complete development of magneto resistive NDI for aircraft.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

- Complete development of durable new materials and thermal barrier coatings for naval gas turbine hot sections; environmental barrier coatings for ceramics/composites for gas turbine engines; new thermal barrier technology; materials and processes for high temperature turbine disks; and higher temperature aluminum alloys for propulsion.
- Complete development of calcium magnesium aluminum-silicate (CMAS) resistant thermal barrier coatings.
- Complete development of nickel-aluminized thermal barrier coating which will be phase compatible with turbine blade alloys.
- Complete development of standardized road test methodology and coating test metrics for the USMC vehicles.
- Complete development of single coat corrosion control coatings for CHT ship tank.
- Complete development of ultrasonic imaging NDI for aircraft.
- Complete NDE/NDI technologies for damage detection in composite materials.
- Initiate development of a revolutionary new thermal spray technology for repair and refurbishment of worn and/or corroded components on ships, aircraft and combat vehicles.

	FY 2005	FY 2006	FY 2007
SEA BASING TECHNOLOGIES	0	6,274	18,815

This activity includes development and advancement of technologies to support Seabasing Future Navy Capabiliy enablers and the future development of Sea Basing innovative naval prototypes. Areas include: advanced hull forms, propulsion, and materials to support high speed, shallow draft, and beachable connectors; innovative connector interface and transfer technologies; advanced wave and position sensors and autonomous controls to support vessel to vessel interfaces; and autonomous conveyance systems to support automated and integrated warehousing.

This effort initiates in FY 2006. The increase from FY 2006 and FY 2007 is due to the continuation of FY 2006 efforts for an entire year as well as initiation of new Seabasing efforts.

FY 2005 Accomplishments:

- No funds were budgeted for this activity in FY 2005.

FY 2006 Plans:

- Initiate evaluation of seabasing technologies that may include predictive, wave motion mitigation &

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

compensation systems; advanced lightweight materials (cellular, inflatable, composite, etc); automated contamination sensing, wash-down, collection, and processing systems; automated cargo tracking, storage, and movement technologies; advanced wave and position sensors coupled to autonomous controls to support vessel to vessel interfaces.
- Initiate multiple innovative naval prototype projects for preliminary designs, simulations, and model tests for prototype proof-of-concept with potential topics of: Personnel transfer At-sea, Sea Base Intermediate Transfer Station, Sea Base Connector Test Craft (T-CRAFT)), Automated Cargo and Weapons Transfer, and other novel concepts.
- Initiate process for awards lasting less than 12 months, design reviews/evaluations resulting in down-selection for Phase II awards for detailed prototype designs and head-to-head model testing.

FY 2007 Plans:

- Continue all efforts of FY2006 less those completed in FY2006.
- Complete evaluation of potential new Seabasing INP efforts.
- Initiate scale-up efforts of FY 2006 programs for detailed design, construction, and land-based testing of the selected prototypes.
- Initiate research of emerging technologies in the area of Skin Friction Drag Reduction.

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ADVANCED FOULING AND CORROSION CONTROL COATINGS	5,403	5,600

FY 2005 - In this effort, combinatorial research techniques were used to synthesize new polymers and formulated libraries of coatings to be evaluated for ship hull antifouling, fouling release, or anticorrosion coatings.

FY 2006 - This effort supports advanced fouling and corrosion control coatings research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

	FY 2005	FY 2006
ADVANCED MAGNETIC RESONANCE IMAGING	0	500

This effort supports advanced magnetic resonance imaging research.

	FY 2005	FY 2006
ADVANCED MATERIALS AND INTELLIGENT PROCESSING CENTER	2,033	0

This effort developed the underlying science of Liquid Injection Processing when a multitude of material constituents are present.

	FY 2005	FY 2006
ADVANCED REINFORCED MATERIALS AND NEW MATERIALS RESEARCH FOR AIRCRAFT TIRES	963	0

This effort supported Advanced Reinforced Materials and New Materials Research for aircraft tires.

	FY 2005	FY 2006
AGILE VACCINOLOGY	2,970	0

This effort explored different genetic vaccine modalities (e.g., viral vectored, viral replicons, plasmid) for response in vitro and in animal models of infection for anthrax, plague, malaria, and dengue. Emphasis was on discovery of novel antigenic sequences in the pathogens and rapid, flexible deign of corresponding vaccines which ultimately enabled DOD to rapidly respond to threats posed by emerging pathogens or biowarfare agents.

	FY 2005	FY 2006
ALUMINUM FABRICATION UTILIZING THREE-DIMENSIONAL PRINTING	1,350	0

This effort defined, developed and demonstrated a three dimensional printing (3DP) system on specific DOD applications. This effort advanced the potential use of the 3DP process and its unique capabilities for the manufacture of components in an e-manufacturing environment.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

	FY 2005	FY 2006
ATMOSPHERIC WATER HARVESTING	963	1,000

FY 2005 - This effort developed and delivered prototype water harvesting device(s) to condense water from the air. The device is self-powered, using photovoltaics to gather power from the sun and store it in batteries. The battery power was used to operate various mechanical and/or solid state cooling devices to condense vapor from the air. This device could have dual use (commercial) applicability.

FY 2006 - This effort supports atmospheric water harvesting research.

	FY 2005	FY 2006
AUTOMATED LANGUAGE TRANSLATION TOOLS FOR INTELLIGENCE COMMUNITY	0	1,000

This effort supports automatic language translation tools for intelligence community research.

	FY 2005	FY 2006
AUTOMATED VIDEO THREAT RECOGNITION	0	1,800

This effort supports automated video threat recognition research.

	FY 2005	FY 2006
BIOSENSOR FOR DEFENSE APPLICATIONS	1,928	1,500

FY 2005 - This effort developed advanced technology for autonomous sensor platforms in marine environments.

FY 2006 - This effort supports biosensor for defense applications research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

	FY 2005	FY 2006
COATING AND POLYMERIC FILMS FOR NAVAL APPLICATIONS	965	0

This effort included the development of natural polymers based on filled soybean protein/vegetable oil derivatives for possible use in a chaff cartridge; the preparation of polylactic acid/cellulose acetate blends that optimize softening point and biodegradability considerations; and the development of novel exfoliated clay reinforcements to provide physical and thermal reinforcement and a mechanism to encourage biodegradation in high salt environments.

	FY 2005	FY 2006
CONTINUATION OF HYDRATE DESALINATION TECHNOLOGY	2,027	1,700

FY 2005 - This effort developed a novel method to desalinate seawater using gas hydrate crystals.

FY 2006 - This effort supports the continuation of hydrate desalination technology research.

	FY 2005	FY 2006
CUTTING TOOLS FOR AEROSPACE MATERIALS	3,278	0

This effort created a virtual, collaborative environment connecting the military, industrial, and academic materials communities to support state-of-the-art aerospace materials research focused on Naval aviation issues. The primary focus was to develop and construct the user base and to integrate a consortium of partners into an electronic web-based portal.

	FY 2005	FY 2006
DURABILITY OF COMPOSITE MATERIALS AND STRUCTURES	1,254	1,250

FY 2005 - This effort established the durability characteristics of composite materials used in Naval structures in the severe marine environment.

FY 2006 - This effort supports durability of composite materials and structures research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

	FY 2005	FY 2006
ENVIRONMENTAL MICRO-BIOLOGICAL ENERGY HARVESTING	0	1,200

This effort supports environmental micro-biological energy harvesting research.

	FY 2005	FY 2006
FRICTION STIR WELDING	0	1,200

This effort supports friction stir welding research.

	FY 2005	FY 2006
HIGH PERFORMANCE LONG LASTING LO MATERIALS FOR NAVY STEALTH APPLICATIONS	2,893	0

This project developed high performance, long lasting conductive polymeric materials for Naval aircraft gap sealants for stealth applications. Conductive gap sealants based on polymers loaded with carbon nanotube offered the potential for significant improvements over current technology, specifically in weight-savings, increased absorption/deflection potential, service life, and cost.

	FY 2005	FY 2006
HUMAN SYSTEMS TECHNOLOGY	963	0

This effort supported research on advanced visual displays, advanced tactile displays, and improved algorithms for knowledge discovery and data mining from large data sets.

	FY 2005	FY 2006
INTEGRATED WMD DETECTION AND COLLECTION SYSTEM	968	0

This effort supported Integrated WMD Detection and Collection System.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

	FY 2005	FY 2006
INTELLIGENT PROCESSING OF MULTIFUNCTIONAL COMPOSITE MATERIALS	0	1,500

This effort supports intelligent processing of multifunctional composite materials research.

	FY 2005	FY 2006
MARINE MAMMAL RESEARCH PROGRAM	1,063	0

An assessment of dolphin hearing sensitivity using electrophysiological measurements was conducted.

	FY 2005	FY 2006
MAST-MOUNTED IN PORT VIDEO FORCE PROTECTION SURVEILANCE SYSTEM	0	3,400

This effort supports Smast-mounted in port video force protection surveilance system research.

	FY 2005	FY 2006
METHANE DESALINATION SYSTEMS	0	1,000

This effort supports methane desalinations systems research research.

	FY 2005	FY 2006
MICROSYSTEM FUZE/SAFE AND ARM DEVICES	964	0

This effort developed and implemented advanced micro-system testing, characterization, and modeling and design to establish and ensure reliability standards specifically for application in Micro Electrical Mechanical Systems (MEMS) based fuzing, safety, and arming components and packaging.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

	FY 2005	FY 2006
MOTION COUPLED VISUAL ENVIRONMENT (MOCOVE) FOR MOTION SICKNESS RELIEF	963	0

This effort supported Motion Coupled Visual Environment (MOCOVE) for motion Sickness Relief (transferred from Title IV-DHP). It also initiated a study to test technologies for reducing the impact of motion sickness on performance in environments such as land-based Command and Control vehicles and shipboard Command Information Centers.

	FY 2005	FY 2006
MULTIFUNCTION COMPOSITES FOR NEXT NAVY SEAFRAMES	0	2,500

This effort supports multifunction composites for nexy Navy seaframes research.

	FY 2005	FY 2006
NATIONAL CENTER FOR ADVANCED SECURE SYSTEMS RESEARCH	0	2,800

This effort supports National Center for Advanced Secure Systems Research.

	FY 2005	FY 2006
NATIONAL UNMANNED UNDERSEA VEHICLE (UUV) TEST AND EVALUATION CENTER (NUTEC)	5,766	0

This effort provided UUV test capability upgrades, for use by all Navy UUV programs, in four areas: (1) UUV ground-truth measurement and sensor stimulation upgrades, including tracking and target systems; (2) UUV test data management and communication systems, including remote site testing capabilities and UUV analysis systems; (3) UUV launch and recovery support systems and portable in-water test support equipment; and (4) environmental monitoring systems and upgrades to the NUTEC Test Environment Assessment Laboratory and to support UUV testing in mission-specific environments.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

	FY 2005	FY 2006
NAVAL TRAINING, PERFORMANCE, AND EXPERTISE	963	0

The primary objectives were: 1) disseminate current and create new state-of the-art "how to" handbooks to train and educate sailors and Marines, and 2) continue research on the use of expertise models to enhance situational awareness of combat pilots under stress.

	FY 2005	FY 2006
NONLINEAR SYSTEMS RESEARCH CENTER	1,260	1,000

FY 2005 - This effort supported damage detection which developed a novel device to detect damage in materials using chaotic forcing and fiber optic readout to discover changes in a material’s response. The MEMS gyros array effort was a working on-chip surface emitting laser technology for displacement sensing of a MEMS gyro array.

FY 2006- This effort supports the Nonlinear Systems Research Center.

	FY 2005	FY 2006
NOVEL MATERIALS SYNTHESIS AND CHARACTERIZATION	3,376	0

This effort supported complete assembly and integration of pulse power device; established and integrated time-resolved instrumentation, including multipoint visar and spectroscopic capabilities, to the pulsed power device; conducted and implemented target chamber design; developed analytical methods to analyze wave profile data obtained from experimental measurements; conducted material characterization experiments to determine the time scales and loading conditions associated with the initiation of mechanically stimulated metal/polymer reactions, material properties of novel structural and reactive materials; and extended the characterization capabilities to very high dynamic loading regimes.

	FY 2005	FY 2006
OPTIMIZING ADAPTIVE WARRIOR PERFORMANCE	2,026	1,700

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2005 - This effort procured dedicated magnetic resonance imaging system and conducted training and initial studies.

FY 2006 - This effort supports optimizing adaptive warrior performance research.

	FY 2005	FY 2006
PARTNERSHIP SIMULATION LABORATORY FOR MILITARY HEALTH PROFESSIONS AND FIRST RESPONDER EDUCATION	2,412	1,000

FY 2005 - This effort delivered an entire authoring system for subject matter experts to create high-fidelity and persistent world simulation content that was pedagogically structured for deep and rapid experience-based learning.

FY 2006 - This effort supports the Partnership Simulation Laboratory for Military Health Professions and First Responder Education.

	FY 2005	FY 2006
POSS BIOFILM PACKAGING MATERIALS	0	1,000

This effort supports POSS biofilm packaging materials research.

	FY 2005	FY 2006
RAPID AND HIGHLY SENSITIVE DETECTION OF BIOWARFARE AGENTS	1,156	0

This effort supported semi-conducting metal oxide (SMO)-based sensors that were modified to increase sensitivity and reduce power requirements. These portable, low cost sensors were evaluated with toxicant stimulants to assess their theoretical parts-per-billion sensitivity.

	FY 2005	FY 2006
RAPID DETECTION OF BIOWARFARE AGENTS IN WATER	2,026	1,500

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2005 - This effort developed technologies for rapid detection of, and response to, airborne biological and chemical agents in battlefield and key urban environments. This work supported the development of antibody-based and DNA-based detection systems in a ChemArray Chip (impedance imaging sensing system), and of data/models to predict the proper placement of real-time sensors in indoor environments for antiterrorism applications.

FY 2006 - This effort supports rapid detection of biowarefare agents in water research.

	FY 2005	FY 2006
SENSORNET	11,574	0

This effort supported the continued design and development of an information technology infrastructure toward realization of a national comprehensive incident management system. The ultimate goal of this incident management system, called SensorNet, was to provide near-real-time, reliable and secure, collection, processing, management, and dissemination of sensor data (weather, radiological, chemical and video).

	FY 2005	FY 2006
TITANIUM MATRIX COMPOSITES	1,543	0

This effort identified bulk amorphous titanium alloy compositions with high glass formability and developed melting, casting and processing techniques to optimize alloy microstructure.

	FY 2005	FY 2006
TITANIUM-BASED ALLOY FOR ADVANCED AEROSPACE APPLICATIONS	1,350	1,300

FY 2005 - This effort identified bulk amorphous titanium alloy compositions with high glass formability and developed melting, casting and processing techniques to optimize alloy microstructure. Microstructural optimization required controlled devitrification of crystalline regions within an amorphous matrix and processing to achieve the balance of microstructural features required for the increased ductility necessary in naval aircraft applications. This class of alloys could offer very high strength to weight ratios for use as structural members in naval aircraft, if the damage tolerance of these materials can be improved significantly.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2006 - This effort supports titanium-based alloy for advance aerospace applications research.

	FY 2005	FY 2006
TRANSPORTABLE TRANSPONDER LANDING SYSTEM	0	1,500

This effort supports transportable transponder landing system research.

	FY 2005	FY 2006
VIRTUAL CLINICAL LEARNING LAB (VCLL)	1,928	2,000

FY 2005 - This effort supported construction of an active virtual environment infrastructure using game-based technologies and development techniques to serve as the organizing framework of a platform for post/co-didactic learning and training simulations where students and practitioners in the healthcare disciplines acquire and practice critical experiential skills.

FY 2006 - This effort supports the Virtual Clinical Learning Lab.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:

PE 0308601N Modeling and Simulation Support
PE 0601103N University Research Initiatives
PE 0601152N In-House Laboratory Independent Research
PE 0601153N Defense Research Sciences
PE 0602123N Force Protection Applied Research
PE 0602747N Undersea Warfare Applied Research
PE 0603236N Warfighter Sustainment Advanced Technology
PE 0603512N Carrier Systems Development
PE 0603640M USMC Advanced Technology Demonstration (ATD)
PE 0603721N Environmental Protection
PE 0603724N Navy Energy Program

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

PE 0604561N SSN-21 Developments
PE 0604703N Personnel, Training, Simulation, and Human Factors
PE 0604771N Medical Development
PE 0605152N Studies and Analysis Support, Navy
PE 0708011N Industrial Preparedness

NON-NAVY RELATED RDT&E:

PE 0408042N.SEA National Defense Sealift Fund
PE 0601102A Defense Research Sciences
PE 0602105A Materials Technology
PE 0602211A Aviation Technology
PE 0602303A Missile Technology
PE 0602601A Combat Vehicle and Automotive Technology
PE 0602705A Electronics and Electronic Devices
PE 0602709A Night Vision Technology
PE 0602716A Human Factors Engineering Technology
PE 0602785A Manpower/Personnel/Training Technology
PE 0602786A Warfighter Technology
PE 0602787A Medical Technology
PE 0603002A Medical Advanced Technology
PE 0603003A Aviation Advanced Technology
PE 0601102F Defense Research Sciences
PE 0602102F Materials
PE 0602202F Human Effectiveness Applied Research
PE 0602203F Aerospace Propulsion
PE 0602204F Aerospace Sensors
PE 0602702F Command Control and Communications
PE 0603216F Aerospace Propulsion and Power Technology
PE 0603716D8Z Strategic Environmental Research Program
PE 0602712E Materials and Electronics Technology
PE 0603851D8Z Environmental Security Technical Certification Program

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

D. ACQUISITION STRATEGY:

Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N
PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
RF SYSTEMS APPLIED RESEARCH	60,316	64,642	42,619	33,378	44,907	45,199	45,583

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Radio Frequency (RF) Systems Applied Research Program addresses technology deficiencies associated with Naval platform needs for new capabilities in RF Surveillance, RF Electronic Warfare, Navigation, RF Solid State Power Amplifiers, RF Vacuum Electronics Power Amplifiers, and Supporting RF Electronics Technologies. The program supports development of technologies to enable capabilities in Missile Defense, Directed Energy, Platform Protection (including Electric Warship), Time Critical Strike, and Information Distribution. RF Systems Applied Research Developments directly support the Department of Defense Joint Warfighter Plan and the Defense Technology Area Plans. Activities within this Program Element (PE) have attributes that focus on enhancing the affordability of warfighting systems. The program also provides for technology efforts to maintain proactive connectivity and collaboration between Department of the Navy (DON) Science and Technology (S&T) and Joint, Navy, and Marine Corps commands worldwide. This PE supports the Future Naval Capabilities (FNC) Programs in Communications Technology, Supporting Technologies, and RF Electronic Warfare (EW) Technology.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N
PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	64,640	47,302	53,521
Congressional Action	0	18,050	0
Congressional Undistributed Reductions/Rescissions	-50	-710	0
Execution Adjustments	-3,494	0	0
FY 2005 SBIR	-905	0	0
GWOT Counter IED Efforts	125	0	0
Program Realignment	0	0	-10,803
Rate Adjustments	0	0	-99
FY 2007 President's Budget Submission	60,316	64,642	42,619

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
Performance Metrics are discussed within the R-2a.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
RF SYSTEMS APPLIED RESEARCH	44,697	46,592	42,619	33,378	44,907	45,199	45,583

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses technology deficiencies associated with Naval platform needs for new capabilities in Radar Frequency (RF) Surveillance, RF Electronic Warfare, Communications, Navigation, RF Solid State Power Amplifiers, Vacuum Electronics Power Amplifiers, and Supporting RF Electronics Technologies. The project supports development of technologies to enable capabilities in Missile Defense, Directed Energy, Platform Protection (including Electric Warship), Time Critical Strike, and Information Distribution. RF Systems Applied Research Developments directly support the Department of Defense Joint Warfighter Plan and the Defense Technology Area Plans. Projects within this Program Element (PE) have attributes that focus on enhancing the affordability of warfighting systems. The project also provides for technology efforts to maintain proactive connectivity and collaboration between Department of the Navy (DON) Science and Technology (S&T) and Joint, Navy, and Marine Corps commands worldwide.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
ELECTRONICS AND COMMUNICATIONS TECHNOLOGIES	17,335	15,968	10,015

Sea Shield (formerly Electronics and Communications Technologies) provides technologies developed under the Future Naval Capabilities (FNC) Program; specifically the Multi-Source ISR to the Warfighter and the Advanced Electronic Sensor Systems. Emphasis is placed on the development of Electronic Warfare, Multi-Function and advanced multifunction RF and microwave electronic components. Included are; the development of capabilities to increase the effectiveness in countering a broad range of threats from anti-ship missiles, and increasing the overall real time situational awareness of operational forces through the detection and processing of RF signals designed with low probability of detection characteristics. The electronics components are developed, optimized and demonstrated in component chains that must meet size, weight and power requirements and will

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

form the basis of new multifunction modules to help support these functions.

The funding profile from FY06 to FY07 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Multi-Source ISR to the Warfighter and Advanced Electronic Sensor Systems for Missile Defense.

Funding decreases FY 2005 to FY 2007 due to completion of initiatives and technology maturing and moving into Budget Activity 3.

FY 2005 Accomplishments:

• Continued the Electronic Support(ES) Detection of Low Probability of Intercept (LPI) Periscope Detection Radar effort and performed at-sea testing of the ultra-wideband chirp subsystem with an instantaneous bandwidth of 2.0 GHz.
• Continued the Electronic Attack (EA) Techniques to Counter Advanced Threats effort by completing 90% of the EA technique modules for the advanced techniques generator.
• Continued the effort to improve Direct Digital Synthesizers (DDS) and power digital to analog converter (Power-DAC) device performance and yield with a target of up to 20 GHz.
• Completed Next Generation Buoyant Cable (NGBCA) and transitioned to development of Next Generation Communications at Speed and Depth (NGCSD) funded under PE 0603271N.
• Completed Advanced Multi-function Radio Frequency Concept (AMRFC) Test Bed successfully.
• Completed fabrication and testing of linearizers optimized with Gallium Nitride (GaN) high power amplifiers having a minimum of 4 GHz of bandwidth.
• Completed initial Silicon Carbide (SiC) RF life tests, demonstrated >106 hour lifetimes, and transferred results into the manufacturing technology. Industry has internally funded further testing.
• Completed development of True Time Delay (TTD) digital signal processing techniques that support affordable multi-GHz bandwidth RF microwave transmitter (TX) beamsteering. Simulations demonstrate feasibility for integration into DDS and Power-DAC components, and are planned for insertion into TX arrays to be initiated in FY07 Multi-Function Electronics Warfare (MFEW) and other multi-function systems.
• Initiated AMRFC Version 2 (V2) renamed MFEW program and aligned with DD(X), compliant to new DODI 5000.2 acquisition rules as the Technology Development Phase, to build an Electronic Warfare (EW) Advanced Development Model (ADM) for the DD(X) program using the technology from the AMRFC testbed as the basis.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

• Selected the system design and architecture for the ADM and awarded contracts to produce the major hardware pieces. This system will maintain the scalability and multi-functionality from the AMRFC V1 program's architecture. This will enable adding the communications and radar functions when the next generation of transmit array is developed (starts in FY07 through FY11). Program will move from RF Communications Technology to Electronics and Communications Technology in FY06.
• Initiated highly integrated and affordable receiver (RX) component optimization supporting AMRFC/multifunction electronic warfare (MFEW) with a transition target of FY08. This includes the optimization of entire component chains of Low Noise Amplifier (LNA), Analog-to-Digital Converters (ADC's), tunable filters, channelizers, and radiating elements specific to the MFEW receiver, 2-D electronically scanned arrays. Objectives are to reduce cost to 1/3 of current multi-function RF systems for a minimum of 6-18 GHz bandwidth.

FY 2006 Plans:

• Continue all efforts of FY 2005 less those noted as completed above.
• Complete the ES Detection of LPI Periscope Detection Radar effort by performing laboratory testing of the frequency modulated continuous wave (FMCW) and Advanced Phase Coded LPI radar detection subsystems with the BLQ-10(V) system.
• Initiate development of RF technologies that support advances in receiver architecture, antenna performance, subsystem miniaturization, decoys and advanced signal processing.
• Initiate establishment of an industrial standard appropriate for the demonstration of >106 hour lifetime for RF life testing of GaN based Millimeter-Wave Integrated Circuits (MMICs) and devices and being to apply this standard to state-of-the-art (SOA) MMICs and devices.
• Initiate component chain optimization for AMRFC MFEW transmitter technology with a target of meeting FY11 transition target date.

FY 2007 Plans:

• Continue all efforts of FY 2006 less those noted as completed above.
• Complete the EA Techniques to Counter Advanced Threats effort by development of 100% of the EA technique modules for counter terminal and counter targeting.
• Complete initial phase of GaN HEMT life testing with demonstration of greater than 104 hour lifetimes for 175 degree channel temperatures.
• Initiate demonstration packaging techniques to provide cost reduction and affordability for modules,

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

including component architecture, packaging, and scale of integration optimization.
• Complete the Shipboard Electro-optic/Infrared (EO/IR) Closed Loop Self Protection effort by developing additional jam codes and tracking algorithms to support final at-sea testing of the Shipboard Integrated Electro-Optic Defense Systems (SHIELDS) hardware. This effort previously funded in PE 0602123N.

	FY 2005	FY 2006	FY 2007
RF ELECTRONIC WARFARE TECHNOLOGY	6,324	9,342	9,859

Supports technologies that enable the development of affordable, effective and robust Electronic Warfare (EW) systems that will increase the operational effectiveness and survivability of U.S. Naval units. Emphasis is placed on non-optical passive sensors and active and passive Radio Frequency Countermeasure (RFCM) systems that exploit and counter a broad range of electromagnetic threats. The focus is on maintaining near perfect real-time knowledge of the enemy; countering the threat of missiles to deployed Naval forces; precision identification and location of threat emitters; and, development of technologies that have broad application across multiple disciplines within the EW mission area.

FY06 increase is due to a focus on counter threat technologies.

FY 2005 Accomplishments:

Technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, Unmanned Air Vehicles (UAVs), and EW Enabling Technology continues. Some specific accomplishments include:
• Continued to develop a new RF detection process at Millimeter Wave (MMW) frequencies for wideband, low cost signal detection systems for high probability of intercept wideband receivers utilizing ultra high dynamic range photonics. (NRL)
• Continued the fabricating a hardware breadboard incorporating range/phase correction algorithms for offset Synthetic Aperture Radar (SAR) countermeasures and examined a planar geometry arrangement of receive antennas to obtain phase and delta-frequency data and resolve ambiguities. (NRL)
• Continued countermeasures technology and algorithm development efforts against wireless communications and transitioned most highly effective techniques into operational Navy and Air Force electronic attack (EA) systems currently being used in the Global War On Terrorism. (NRL)
• Continued the Countermeasures (CM) for Wideband Antiship Threats effort with a 6-month vulnerability analysis of seeker discrimination and home-on-jam (HOJ) subsystems to the ECM system.
• Developed jamming technology to counter Radio-Controlled Improvised Explosive Devices (RCIED). System was

transitioned to the Joint IED Defeat Task Force. (NRL)
• Completed the development and demonstration of key technologies that will enable an air-launched unmanned platform carrying an advanced EW payload for the Suppression of Enemy Air Defense (SEAD) mission. (NRL)
• Completed the development of key capabilities of an Autonomous MMW receiver and coherent techniques to counter 18-40 GHz airborne threats. (NRL)
• Completed the Hybrid Interferometer Technology Development effort with the analysis and modeling to develop and refine the detailed Direction Finding (DF) antenna design and the fabrication and lab demonstration of the DF antenna to achieve a DF accuracy of 0.1 degree.
• Initiated the development of an integrated Digital EW, EA and ES suite using a tightly coupled common architecture so that there is a synergistic coupling between the sub-functions of ES and EA. (NRL)

FY 2006 Plans:

Technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, UAVs, and EW Enabling Technology continues.
• Continue all efforts of FY 2005 less those noted as completed above.
• Complete advanced wireless communication countermeasures systems technology and algorithm developments. (NRL)
• Complete the CM for Wideband Antiship Threats effort with closed loop software testing of six electronic CM techniques.
• Complete development of RCIED countermeasures for urban environment applications. (NRL)
• Complete the development of SAR countermeasures false image focusing algorithms with a laboratory demonstration. (NRL)
• Initiate the Specific Emitter Identification (SEI) Capabilities Extension effort with development of two hardware independent algorithms to address known shortfalls in existing SEI systems.
• Initiate development of RF technologies that support advances in receiver architecture, antenna performance, subsystem miniaturization, decoys and advanced signal processing.
• Initiate the EW Tactical Decision Algorithms (TDA) for Satellite Communications effort by evaluating two atmospheric propagation models to assist in visualizing the impact of satellite communications on future planning and tactics.
• Initiate the Autonomous Classification of Low Probability of Intercept (LPI) Radar Emitters effort to develop an advanced signal processing architecture using algorithms evaluated using a computer equipped with two 1000 MHz Intel Xenon processors.
• Initiate the Unmanned Vehicle Integrated Electronic Warfare Payload (UVIEWP) effort for employment of

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

modeling and simulation tools to optimize technique selection to maximum electronic attack effectiveness in counter targeting and counter surveillance operations.
• Initiate the Advanced Pulse De-interleaving effort to investigate methods of improving pulse de-interleaving that will support detection and identification of complex emitters and allow sorting of multiple tracks and support raid analysis.
• Initiate the investigation of MMW technologies to support the development of off board and onboard countermeasures.
• Initiate the development and demonstration of a compact EA technology for tactical unmanned vehicle systems to counter wideband, spread spectrum active electronically steered array radars. (NRL)

FY 2007 Plans:

Technology development in the areas of Tactical Aircraft, Surface Ships, submarines, UAVs, and EW Enabling Technology continues.
• Continue all efforts of FY 2006 less those noted as completed above.
• Complete the Autonomous Classification of LPI Radar Emitters effort by testing and evaluating feature extraction algorithms on actual digitized LPI radar signals.
• Complete the Advanced Pulse De-interleaving effort by lab and field testing of the de-interleaving algorithms with an Electronic Support Enhancement (ESE) processor used for the Surface Electronic Warfare Improvement Program (SEWIP).
• Complete the UVIEWP effort by conducting a multiplatform demonstration of an autonomous UVIEWP escort constellation that provides countertargeting and countersurveillance for expeditionary force ships.
• Complete the development of a RF detection process at MMW using photonics. (NRL)
• Complete the SEI Capabilities Extension effort with implementation of advanced SEI algorithms into Windows based SEI software and SEI hardware using a flexible architecture employing IFD-120 Field Programmable Gate Arrays (FPGA) with 3 million gates.
• Initiate the Ka/W Band Miniature Sensor Development effort with Ka/W Band architecture device selection and downconverter subsystem conceptual design.
• Initiate the Countermeasures to Anti-Helicopter Mines effort by reviewing current and previous Army efforts and developing initial countermeasure concepts.
• Initiate the Compact Electro-Magnetic (EM) Source for Improvised Explosive Device (IED) and Engine Defeat effort by measuring the RF impedances of the materials and comparing the results with conventional theory.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

	FY 2005	FY 2006	FY 2007
RF SURVEILLANCE TECHNOLOGY	5,996	9,372	10,272

Emphasizes non-optical advanced sensor and sensor processing systems for continuous high volume theater-wide air and surface surveillance, battle group surveillance, real time reconnaissance and ship defense. Major technology goals include long-range target detection and discrimination, Target Identification (ID) and fire control quality target tracking in adverse weather, background clutter and electronic countermeasure environments.

Increase from FY 05 to FY 06 is due to new surveillance technology efforts.

FY 2005 Accomplishments:

• Continued the Horizon Extension Sensor System (HESS) project with form factored integration of High Power Amplifier (HPA) and development of a Silicon Germanium (SiGe) downconverter in support of HESS and Digital Array Radar (DAR) efforts.
• Continued development efforts to demonstrate signal processing, waveform generation and one dimensional active phased array apertures for Harbor Surveillance and situational awareness.
• Continued broadband-array effort by designing the radiating element and the feed for the single-element approach and fabrication of a 3-element array. (NRL)
• Continued the design and fabrication of Electromagnetic Bandgap (EBG) structures, validate computational-code designs through measurements, and test for isolation of RF waves. (NRL)
• Completed development of prototype level hardware for the Digital Array Radar (DAR) and characterize its performance at the element, sub-array and system levels. Effort will transition to the Knowledge, Superiority and Assurance (KSA) FNC.
• Completed Radar Electronic Counter Countermeasures (ECCM) algorithms and performed and evaluated associated wideband experiments. (NRL)
• Initiated demonstrations of advanced Non-Cooperative Target Recognition (NCTR) algorithms in congested harbor environments.
• Initiated the design and development of a field probe and radome assembly for a real-time calibration technique that will utilize an optical-to-RF distribution network to inject a low-level RF Continuous Wave (CW) signal into each element of a phased array. Demonstrated the polarization properties of a wideband probe using a zero-bias optical detector. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

FY 2006 Plans:

• Continue all efforts of FY 2005 less those noted as completed above.
• Initiate an element level DAR effort on down conversion and digital beam formers.
• Initiate a program to develop and demonstrate methodologies that provide small threat radar detection in the presence of large masking radar returns using an Adaptive Pulse Compression technique. (NRL)

FY 2007 Plans:

• Continue all efforts of FY 2006 less those noted as completed above.
• Complete demonstrations of advanced NCTR algorithms in congested harbor environments by real time implementation of automated parameter extraction algorithms for small surface crafts.
• Complete the development and testing of reconfigurable/tunable EBG structures. (NRL)
• Complete the broadband-array effort by demonstrating a dual polarized array with coincident phase center and true time delay beam steering. (NRL)
• Initiate a harbor surveillance tracking demonstration with integrated automated parameter extraction for small surface craft identification.

	FY 2005	FY 2006	FY 2007
SUPPORTING TECHNOLOGIES	4,687	1,919	1,517

Provides for the radiation, reception, signal control and processing of Very High Frequency (VHF), Ultra High Frequency (UHF), Micro Wave (MW), and MilliMeter Wave (MMW) power for Navy all-weather radar, surveillance, reconnaissance, Electronic Attack (EA), communications, smart weapons, networked sensors, and precision time and navigation systems. The technology developed which includes nanotechnology cannot, for the most part, be obtained through commercial off the shelf (COTS) as a result of the requirements placed on power, frequency, linearity, bandwidth, weight, and size. This activity includes SwampWorks efforts in FY 2005 which developed and demonstrated technologies that addressed emergent and enduring operational problems in an accelerated timeframe. Swampworks initiatives transferred to PE 0603758N in FY06 and out.

FY 2005 Accomplishments:

• Continued effort on superconducting ADC/Programmable digital channelizer combination that derives a Local Oscillator (LO) from an externally supplied signal and, when signals in 2-175 MHz range are supplied to the

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

ADC, outputs software defined bandwidth signal centered on the LO frequency.
• Continued to demonstrate flip-chip bonding of semiconducting and superconducting devices to form a functional hybrid circuit.
• Continued research to enable growth, fabrication, and testing of 6.2-6.3 Angstrom High Electron Mobility Transistors (HEMTS) with alloy channels and barriers. (NRL)
• Continued developing prototype identification algorithms for the lock-logic and Electronic Counter Countermeasures (ECCM) components of the automated RF ASCM threat model. (NRL)
• Continued measuring Monopulse tracking accuracy at low elevation angles using towed targets and low flying aircraft and tracking error mitigation techniques suitable for millimeter wave frequencies. (NRL)
• Continued development to extend the tuning range of band reject filters. (NRL)
• Conducted efforts within Project Shield (Classified program).
• Developed and completed demonstration technologies that addressed emergent and enduring operational problems in an accelerated timeframe.
• Initiated effort on current recycling in superconducting digital circuits.

FY 2006 Plans:

• Continue all efforts of FY 2005 less those noted as completed above.
• Complete effort on a superconducting ADC/Programmable digital channelizer combination that derives 20MHz-20GHz Local Oscillator (LO) for digital down mixing from master clock and outputs software defined bandwidth signal centered on any center frequency in range supplied to ADC.
• Complete the development of prototype identification algorithms for the lock-logic and ECCM components of the automated radio frequency (RF) ASCM threat model and document results. (NRL)
• Complete the 94GHz measurement effort and determine the effect of frequency agility on the diffuse multi-path component and implement a two-antenna configuration to measure atmospheric turbulence. (NRL)
• Complete development of 6.2-6.3 Angstrom Heterojunction Bipolar Transistor (HBT) operating at microwave frequencies. (NRL)
• Initiate the development of analysis/modeling infrastructure and prototype improvement concepts for electronic countermeasures and counter-targeting against RF surveillance threats. (NRL)

FY 2007 Plans:

• Continue all efforts of FY 2006 less those noted as completed above.
• Complete the demonstration of a current recycling technology for superconducting digital circuits that is

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

mature enough to yield a four fold reduction of bias current.
• Complete the proof of feasibility of hybrid Nb Josephson Junction/InP HBTs ADC modulator circuits operating properly at 4K and with 10 GHz clock when the hot InP transistors are <3mm away from the active Josephson junctions.
• Complete the effort to extend the tuning range of band reject filters. (NRL)
• Initiate a demonstration of > 6dB improvement in state of the art, S or X band, band pass, ADC dynamic range.
• Initiate the development of a semiconductor-based frequency selective limiter. (NRL)

	FY 2005	FY 2006	FY 2007
RF SOLID STATE POWER AMPLIFIERS	4,491	4,169	4,501

Provides for the generation of VHF, UHF, MW, and MMW power amplifiers for Navy all-weather radar, surveillance, reconnaissance, electronic attack, communications, and smart weapons systems. The technology developed cannot, for the most part, be obtained through Commercial-Off-the-Shelf (COTS) as a result of the simultaneous requirements placed on power, frequency, linearity, bandwidth, weight, and size.

FY06-FY07 increase is due to the focus on new efforts dealing with the component level power capabilities and duration.

FY 2005 Accomplishments:

• Continued development of MMW Aluminum Gallium Nitride/Gallium Nitride (AlGaN/GaN) wide bandgap High Electron Mobility Transistor (HEMT).
• Continued development of AlGaN HEMT broadband amplifiers for electronic warfare decoys with output powers up to 10 times that achieved with conventional solid state amplifiers.
• Completed development of an Indium Gallium Nitride (InGaN) HEMT with a unity gain cutoff frequency * gate length (ft*lg) product of 20 GHz-microns. (NRL)
• Initiated effort on radiation effects and hardness studies of wide bandgap semiconductors. (NRL)

FY 2006 Plans:

• Continue all efforts of FY 2005 less those noted as completed above.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

FY 2007 Plans:

- Continue all efforts of FY 2006.
- Complete MMW AlGaN/GaN HEMTs effort and transition to communications and missile seeker platforms.
- Complete broadband AlGaN/GaN amplifier effort and transition to communications and missile seeker platforms.
- Initiate work on GaN MMW components at >44 GHz to allow for Extremely High Frequency (EHF) SATCOM insertion.
- Initiate the expansion of scope of the GaN MMW device program.
- Initiate component development in support of multifunctional electronic warfare.

	FY 2005	FY 2006	FY 2007
RF VACUUM ELECTRONICS POWER AMPLIFIERS	3,251	3,385	3,444

Provides for the development of MW, MMW, submillimeter wave power amplifiers for use in Naval all-weather radar, surveillance, reconnaissance, electronic attack, and communications systems. The technology developed cannot, for the most part, be obtained through commercial off the shelf (COTS) as a result of the simultaneous requirements placed on power, frequency, bandwidth, weight, and size. Responding to strong interests from the various user communities, efforts are focused on the development of technologies for high-data-rate communications and high-power high-frequency radar applications. Technologies include techniques for power and efficiency enhancement of millimeter-wave amplifiers, multiple-beam amplifiers, notably the Multi-Beam Klystron (MBK), and physics-based modeling and simulation.

FY 2005 Accomplishments:

- Continued effort to identify and test algorithms to implement in the Telegrapher's Equation Solution for Linear Amplifiers (TESLA) design code for broadband single-beam klystron development.
- Continued effort to develop a four-cavity narrow-band (~2%) S-band MBK at 600 kW peak power and 40% efficiency.
- Continued effort on Michelle v3.0 with addition of Graphical User Interface (GUI) and postprocessor to implement Michelle v4.0 and initiated effort to release the code.
- Initiated effort to develop Ku-band, C-band and Ka-band low distortion Traveling Wave Tubes (TWT’s) for High Data Rate (HDR) communications that will utilize 16 and 32 symbol Quadrature Amplitude Modulation (QAM) waveforms.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

• Initiated research on bandwidth enhancement (~ 6%) techniques for 500 kW S-band MBK. (NRL)

FY 2006 Plans:

• Continue all efforts of FY 2005 less those noted as completed above.
• Complete effort on low distortion TWT for HDR communications. (NRL)
• Initiate research on 3D modeling of beam transport with quadrapole magnetic focusing for high power Ka band TWT. (NRL)
• Initiate effort on the large signal code CHRISTINE to model beam wave interaction with quadrapole focusing effects for beam transport.
• Initiate effort on the gun/collector code MICHELLE with improved interface with the large signal codes CHRISTINE and TESLA.

FY 2007 Plans:

• Continue all efforts of FY 2006.
• Complete the effort on the broadband (~ 6%) S-band MBK performance. (NRL)
• Complete the effort on the release of the gun/collector code MICHELLE v4.0 with improved GUI and postprocessor.
• Initiate effort on experimental demonstration of beam propagation with quadrapole magnetic focusing that will result in a factor of 2 reduction in peak magnetic field compared to Permanent Periodic Magnet (PPM) focusing. (NRL)
• Initiate effort on generation and transport of sheet beam with 5:1 aspect ratio. (NRL)

	FY 2005	FY 2006	FY 2007
RF NAVIGATION TECHNOLOGY	2,613	2,437	3,011

Develops key navigation technologies for Naval Battle Groups, Aircraft, Unmanned Air Vehicles (UAVs), Unmanned Underwater Vehicles (UUVs), Ships, Submarines and other Navy vehicles and platforms. This activity applies leading-edge Science and Technology (S&T) to enhance Global Positioning System (GPS) capabilities in order to make GPS more resistant to noise and jamming. Much of the near-term effort concerns the development of antennas with special features.

FY 2005 Accomplishments:

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

• Continued Digital Antenna Electronics (DAE)-based anti-jam systems with small patch antenna elements using low-loss ceramic materials for an array of 7 elements (less than quarter (1/4)-wavelength elements with spirals).
• Continued to integrate Space-Time Adaptive Processing (STAP) for GPS Antennas. Specific jammer types were addressed in this effort (the signal strength 12 dB below thermal noise could be detected).
• Continued to design the STAP for GPS Antennas in one of the receiver-antenna systems developed in this activity and to strike weapon systems such as Paveway and Tactical Tomahawk (additional 43 dB improvement in AJ capability).
• Continued field testing of the Submarine mast-mounted Controlled Radiation Pattern Antenna (CRPA) to determine if the laboratory performance can be achieved in a more realistic environment; conducted nulling optimization in submarine mast environment for the best broadband nulling performance (achieved 8 elements in 4.25-inch submarine mast).
• Initiated development of GPS Anti-Jam (AJ) processor (Space-Frequency Adaptive Processing (SFAP)) with Poly-Channelized, Code Gated Maximum Likelihood (PC-CGML) technique to cancel the effect of a large number of jammers (up to 8 jammers with 4 array elements).
• Initiated development of GPS AJ Antenna Electronics (AE) with low-cost analog processor technique for Direction of Arrival (DOA) estimation and nulling (up to 60dB nulling capability).
• Initiated development of GPS AJ processor to reliably lock to the GPS carrier signal and in this way make it possible to extract very high precision positional information from the GPS receiver. Carrier slips are a measure of degraded GPS positional performance (vertical and lateral navigation system errors of 40 and 30 cm respectively).

FY 2006 Plans:

• Continue all efforts of FY 2005.
• Complete DAE based anti-jam systems with small patch antenna using low-loss ceramic materials for an array of 7 elements.
• Complete the development of GPS AJ processor to reliably lock to the GPS carrier signal and in this way make it possible to extract very high precision positional information from the GPS receiver. Carrier slips are a measure of degraded GPS positional performance.
• Complete the integration of STAP for GPS Antennas. Specific jammer types will be also addressed in this effort (the signal strength 12 dB below thermal noise could be detected).
• Complete field testing of the Submarine mast-mounted Controlled Radiation Pattern Antenna to determine if

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

the laboratory performance can be achieved in a more realistic environment; complete nulling optimization in submarine mast environment for the best broadband nulling performance (achieved 8 elements in 4.25-inch submarine mast).

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete the design and development of Space-Frequency Adaptive Processing (SFAP) for GPS AJ antenna to improve receiver AJ performance by adding channelization to the existing Code Gated Maximum Likelihood (CGML) receiver; Completed the evaluation of the effectiveness of the Poly-Channel (PC) CGML technique by simulation and build it in software radios (up to 8 jammers with 4 array elements).
- Initiate the Improved GPS/INS Integration using a Particle Filter Accelerator project.
- Initiate the Deeply Integrated Navigation Grade GPS Inertial System project.
- Initiate the Advanced Spoofer Mitigation and Geolocation through Spoofer Tracking project.

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ADVANCED MICROWAVE FERRITE RESEARCH FOR RF SYSTEMS	1,156	1,500

FY 2005 - In FY05 very thick (1 mm) hexagonal ferrite films of outstanding quality were grown by Liquid phase epitaxy. Microwave loss and insertion characterization were performed. Microwave radar circuit tuning continued, and a novel planar MMW antenna was designed and demonstrated.

FY 2006 - This effort supports advanced microwave ferrite research for RF systems.

	FY 2005	FY 2006
BROADBAND ELECTRONICS FOR RF SYSTEMS	0	1,250

This effort supports broadband electronics for RF systems research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

	FY 2005	FY 2006
CENTER FOR MICROWAVE FERRITES AND MULTIFUNCTIONAL INTEGRATED CIRCUITS	0	1,000

This effort supports center for microwave ferrites and multifunctional integrated circuits research.

	FY 2005	FY 2006
CORE REPARATIVE MEDICINE FOR TRAUMATIC INJURIES	0	1,000

This effort supports core reparative medicine for traumatic injuries research.

	FY 2005	FY 2006
GALLIUM NITRATE RF POWER TECHNOLOGY	1,928	1,000

FY 2005 - In FY05 plans were developed to improve the performance and reliability of GaN High Electron Mobility Transistors (GaN HEMTs) for RF power applications by exploiting innovative new methods for the production of GaN HEMT epitaxial material on SiC and by developing novel GaN HEMT device designs and fabrication techniques. Plans to conduct accelerated lifetime test measurements to document improvements were also developed.

FY 2006 - This effort supports gallium nitrate RF power technology research.

	FY 2005	FY 2006
HIGH BRIGHTNESS ELECTRONICS	1,446	0

In FY05 device fabrication and material synthesis of carbon nanostructure for application to 50W, 10 GHz vacuum electronic power amplifier were optimized with respect to; dielectric thickness of the buried line devices, back-gate geometry to maximize field at the emission sites, nanosheet crystallinity and hydrogen content, field uniformity at the cathode surface, and efficiency of electron emission to vacuum.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

	FY 2005	FY 2006
LITHIUM-BASED BATTERY DEVELOPMENT FOR ASSET TRACKING	0	1,000

This effort supports lithium-based battery development for asset tracking research.

	FY 2005	FY 2006
MARITIME SYNTHETIC RANGE	4,148	6,700

FY 2005 - In FY05 this effort developed and enhanced the Maritime Synthetic Range with; increased real-time participation in operational training, creation of synthetic forces, scenario generation, and creation of Common Synthetic Battlespace (CSB) and advanced threat environments.

FY 2006 - This effort supports maritime synthetic range research.

	FY 2005	FY 2006
NOVEL SILICON CARBIDE TECHNOLOGY DEVELOPMENT	963	1,000

FY 2005 - In FY05 an existing SiC epitaxial growth system was modified to accept hydrogen chloride (HCl) gas. Growth with added HCl has markedly increased the growth rates (3 -> 20 microns per hour), improved morphology, and purity (|Ne-Np| less than 1e14cm-3.)

FY 2006 - This effort supports novel silicon carbide technology development research.

	FY 2005	FY 2006
PACIFIC THEATER DATA FUSION TESTBED	2,412	0

In FY05 the project developed a Pacific-theater data fusion testbed initiative and tracking capabilities. The program developed a framework theater-wide sensor fusion center, developed multiple discrimination and tracking algorithms, and provided performance verification from development through testing. An open systems architecture was utilized to support design integration and testing of next generation active and passive sensors, sensor data fusion, and discrimination tracking technology.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

	FY 2005	FY 2006
RADAR/VIDEO FUSION VESSEL AND PORT SECURITY DEMONSTRATION	963	0

In FY05 completed installation of automated identification system, specific emitter identification, and radar at first site and began data collection.

	FY 2005	FY 2006
REPARATIVE HEALTH INITIATIVE	0	1,000

This effort supports reparative health initiative research.

	FY 2005	FY 2006
RF VACUUM ELECTRONICS POWER AMPLIFIERS	963	0

In FY05 the development of design tools for the gun, collector and large signal analysis of vacuum electronics amplifiers with sheet electron beams were initiated and the design of a sheet beam gun using 3D gun code MICHELLE was demonstrated.

	FY 2005	FY 2006
WIDE BANDGAP MATERIALS FOR POWER ELECTRONICS	1,640	2,600

FY 2005 - In FY05 plans to; reduce thermal strain-induced structural defects (which adversely affect device performance), reduce unintentional impurities, and allow more reproducible and affordable product were developed. This would have the effect of further improving the performance and capability of DOD's high power electronics by reducing the defect densities in power semiconductor substrates and thin device films. The contractor met with scientists from the Naval Research Laboratory and an approach to testing which will validate progress was defined.

FY 2006 - This effort supports wide bandgap materials for power electronics research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0601153N (Defense Research Sciences)
PE 0602114N (Power Projection Applied Research)
PE 0602123N (Force Protection Applied Research)
PE 0603114N (Power Projection Advanced Technology)
PE 0603123N (Force Protection Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)

NON NAVY RELATED RDT&E:
PE 0601102A (Defense Research Sciences)
PE 0601102F (Defense Research Sciences)
PE 0602204F (Aerospace Sensors)
PE 0602702F (Command, Control, and Communications)

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	69,447	62,470	48,718	50,243	50,809	51,407	52,011

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) provides the unique, fundamental programmatic instrument by which basic research on the natural environment is transformed into technological developments that provide new or enhanced warfare capabilities for the Battlespace Environment (BSE). The objectives of this program are met through measuring, analyzing, modeling and simulating, and applying environmental factors affecting Naval material and operations in the BSE. This program provides for BSE technological developments that contribute to meeting top joint warfare capabilities established by the Joint Chiefs of Staff, with primary emphasis on Joint Littoral Warfare and Joint Strike Warfare.

This PE fully supports the Director of Defense Research and Engineering’s Science and Technology Strategy and is coordinated with other DoD Components through the Defense Science and Technology Reliance process. Work in this program is related to and fully coordinated with efforts in accordance with the on-going Reliance joint planning process. There is close coordination with the US Air Force and US Army under the Reliance program in the BSE categories of Lower Atmosphere, Ocean Environments, Space & Upper Atmosphere, and Terrestrial Environments. Within the Naval Transformation Roadmap, the investment will contribute toward achieving each of the "key transformational capabilities" required by Sea Strike, Sea Shield, and Sea Basing. Moreover, environmental information, environmental models, and environmental tactical decision aids that emerge from this investment will form one of the essential components of FORCEnet (which is the architecture for a highly adaptive, human-centric, comprehensive maritime system that operates from seabed to space). The Navy program includes efforts that focus on, or have attributes that enhance, the affordability of warfighting systems.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	69,601	49,793	50,353
Congressional Action	0	13,425	0
Congressional Undistributed Reductions/Rescissions	-53	-748	0
Execution Adjustments	866	0	0
FY 2005 SBIR	-967	0	0
Program Realignment	0	0	-1,504
Rate Adjustments	0	0	-131
FY 2007 President's Budget Submission	69,447	62,470	48,718

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
All Science and Technology model improvements undergo a rigorous validation, verification and evaluation against quantifiable metrics before being accepted for transition into operations. In Marine Meteorology, for example, typical improvements over the past decade have amounted to a gain in skill of one forecast-day (i.e., the 4-day forecast is now as skillful as the 3-day forecast of a decade ago), and tropical cyclone forecast track error has been reduced by 50%. It is expected that future increases in skill will continue at or above this pace.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	48,426	49,045	48,718	50,243	50,809	51,407	52,011

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project provides technologies that form the natural environment technical base on which all systems development and advanced technology depend. Furthermore, this technical base provides developments that may be utilized in the Future Naval Capabilities programs: Organic Mine Countermeasures (MCM) and Autonomous Operations. This project contains the National Oceanographic Partnership Program (NOPP) (Title II, subtitle E, of Public Law 104-201) and efforts aimed at understanding and predicting the impacts of underwater sound on marine mammals.

Major efforts of this project are devoted to: gaining real-time knowledge of the Battlespace Environment (BSE), determining the natural environment needs of regional warfare, providing the on-scene commander with the capability to exploit the environment to tactical advantage and, developing atmospheric research related to detection of sea-skimming missiles and strike warfare. This project provides natural environment applied research for all fleet operations and for current or emerging systems. Major developments are routinely transitioned to the Fleet Numerical Meteorology and Oceanography Center and to the Naval Oceanographic Office where they are used to provide timely information about the natural environment for all fleet operations.

Joint Littoral Warfare efforts address issues in undersea, surface, and air battlespace. Efforts include ocean and atmospheric analysis and prediction for real-time description of the operational environment, shallow water acoustics, multiple-influence sensors for undersea surveillance and weapon systems, and influences of the natural environment on MCM and Anti-Submarine Warfare (ASW) systems. Joint Strike Warfare efforts address issues in air battlespace dominance. Efforts include influences of the natural environment on air operations, electromagnetic (EM)/electro-optic (EO) systems used in intelligence, surveillance, reconnaissance, targeting, bomb damage assessment, and detection of missile weapon systems. They also include improvements in tactical information management about the BSE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
BATTLESPACE ENVIRONMENT (BSE) CONCEPT ENABLERS	18,636	0	0

This activity focuses on concept enablers for the Battlespace Environment (BSE) which represent technology developments that are expected to provide revolutionary enabling capabilities, but require a long period of development. Consideration is routinely given to the goals of this work to ensure that they are adequate for the presumed Naval warfare needs as reflected in higher level Navy Science and Technology (S&T) strategy. This particular activity is most sensitive to opportunities as presented by breakthroughs in the basic research domain which may represent new opportunities for achieving goals of the BSE Concept Enablers activity. The ever recurring theme of the BSE Concept Enablers activity is to advance technologies that offer the warfighter the greatest capabilities for gaining "advantage" over the natural environment, both to increase his warfighting ability and to deny an adversary any “home field” advantage. The aims of this activity are fully consistent with the Navy Transformation Roadmap strategy.

The transition to a revised activities structure in this PE resulted in a 100% decrease in FY 2006 and FY 2007. FY 2006 and out BSE activities are reflected elsewhere within this PE.

FY 2005 Accomplishments:

- Continued engineered microbial synthesis and processing of energetic materials (Moved into PE 0602435N in FY 2005. Will be moved to PE 0602236N in FY 2006 because of realignment of activities in PE 0602435N and PE 0602123N).
- Continued development of reagentless sensors for weapons of mass destruction/explosives, including luminescent quantum dot-based biosensors and engineered protein based sensors for detection of toxins (e.g., ricin, domoic acid) and explosives (e.g., TNT, RDX). (Will be moved to PE 0602123N in FY 2006 because of realignment of activities).
- Completed development of a new global atmospheric ensemble prediction system for capturing uncertainty in environmental predictions. (NRL)
- Completed the field measurements and analysis of the air-sea interaction research effort with the goal of improving both ocean and atmospheric forecasts. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

The following efforts transition to new activity National Oceanographic Partenrship Program (NOPP) in FY 2006:
- Continued marine mammal program on noise mitigation.
- Continued the following NOPP efforts begun in earlier years: Real-Time Forecasting System of Winds, Waves, and Surge in Tropical Cyclones; the Partnership for Advancing Interdisciplinary Global Modeling (PARADIGM); a Partnership for Modeling the Marine Environment of Puget Sound, Washington; Global Ocean Data Assimilation Experiment (GODAE); Multi-Disciplinary Ocean Sensors for Environmental Analyses and Networks (MOSEAN); and Hybrid Coordinate Ocean Model (HYCOM).

The following efforts transition to new activity Coastal Geosciences/Optics/Biology in FY 2006:
- Continued algorithm developments for novel navigation and communications among multiple Unmanned Undersea Vehicles (UUVs). (NRL)
- Continued development of gravity-based navigation and a prototype accelerometer/gravimeter system for submarines. (NRL)
- Continued work on Advanced Techniques for Net-Centric Warfare to create a Naval Advanced Meteorology and Oceanography (METOC) Broker to reliably find and broker data from new and ad-hoc METOC data providers to the warfighter in an automated manner. (NRL)
- Continued development of a Benthic Unattended Generator to power an autonomous ocean environmental profiler and provide demonstration. (NRL)
- Initiated programs in detection of fish by acoustic methods. (NRL)

FY 2006 Plans:

- Program transitions to new activities as noted in FY 2005 accomplishments.

FY 2007 Plans:

- Program transitions to new activities as noted in FY 2005 accomplishments.

	FY 2005	FY 2006	FY 2007
BATTLESPACE ENVIRONMENT (BSE) SENSORS AND DATA	7,701	0	0

This activity encompasses efforts to develop new, or enhance existing, shipboard, airborne, and spaceborne sensors. Also, appropriate inversion techniques and data handling techniques to obtain, store, and manage environmental data. Data on a variety of processes in the environment are essential for several reasons: the

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

data can serve as input to computer prediction schemes, data can be used to provide characterizations of processes for use in other developments, and data can be used in testing/validating the current understanding of ocean and atmospheric behavior. Consideration is routinely given to the basic research available in Sensors and Data to determine if new opportunities exist that can be exploited to rapidly advance toward the goals of the Battlespace Environment (BSE) Sensors and Data activity. Consideration is also routinely given to the nature of the technical efforts to ensure that they represent the most effective means of achieving progress. Efforts include use of organic sensors to characterize the operational environment in real-time for input into performance prediction of warfighting systems. Developments in the BSE Sensors and Data activity are of importance to littoral oceanography, amphibious warfare, Mine Countermeasures (MCM), and anti-submarine warfare. A main emphasis of work in this area remains the littoral ocean which continues to be seen as the primary battlespace of future conflicts. The BSE Sensors and Data activity supports the Navy Transformation Roadmap strategy by providing required data that can be applied to battlespace characterization in near real-time and employed in intelligence, surveillance, and reconnaissance.

The transition to a revised activities structure in this PE resulted in a 100% decrease in FY 2006 and FY 2007. FY 2006 and out BSE activities are reflected elsewhere within this PE.

FY 2005 Accomplishments:

The following efforts transition to new activity Coastal Geosciences/Optics/Biology in FY 2006:
- Continued development of optical property retrieval techniques to generate sharper images from optical sensors that are often blurred by the environment. (NRL)
- Continued bioluminescence sensor effort with emphasis on needs of the Special Warfare (SPECWAR) forces and Naval Oceanographic Office, survey capabilities, and use of the bioluminescence sensors in joint field measurements with ocean sensors to determine persistence of the bioluminescence signal and the ocean factors controlling the persistence.
- Continued efforts to use space-based optical sensors as input for both active and passive optical MCM sensor performance prediction models.
- Continued to perform field data analysis of physics-based models for hyperspectral imaging of the ocean surface/near-surface to establish what information can be deduced about the optical properties of the ocean’s upper layers.
- Continued model development for diver visibility prediction in support of Explosive Ordnace Disposal (EOD) and SPECWAR operations.
- Continued development of sensors to characterize diver visibility in support of EOD and SPECWAR operations.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

- Continued field test of a shipborne Light Detection and Ranging (LIDAR) system for near surface environmental characterization. (NRL)
- Continued to extend studies of ionospheric scintillation phenomena using satellite-satellite measurements providing near global coverage using the Scintillation and Tomography Receiver in Space (CITRIS) instrument to the Space Test Program Satellite (STPSAT1) mission. (NRL)
- Continued development of innovative naval biosensors, biomaterials, and bioprocess technology.
- Continued to refine algorithms that fuse sediment information extracted from operational sonars with historical sediment databases. (NRL)
- Continued to identify and model the dominant sources of coastal undersea environmental electric and magnetic noise and develop methods to mitigate their affects on multiple sensor detection performance. (NRL)
- Continued a technique using hyperspectral and motion imagery in the Littoral Zone (LZ) which offer new possibilities for exploitation based on previous investigation. (NRL)
- Continued development of adaptive algorithms for image enhancement using an operational MCM electro-optic system and provide a demonstration. (NRL)
- Completed demonstration of littoral environmental nowcasting using airborne electro-optical motion imagery and advanced oceanographic models (NRL).
- Completed modification of NRL algorithm, which clusters features in sidescan imagery to perform 2D clustering (by geospatial X,Y location) of features on electronic charts and determined clutter density (NRL).
- Completed participation in joint field work with other Autonomous Undersea Vehicle (AUV) technology developers and users to test undersea sensors. (NRL)
- Initiated programs for promising new biological and chemical sensors.

The following effort transitions to new activity Physical Oceanography in FY06:
- Continued to develop improved ocean wave prediction, especially shoaling waves, based on the extensive basic research measurement programs in this area over the past decade. (NRL)

FY 2006 Plans:

- Program transitions to new activities as noted in FY 2005 accomplishments.

FY 2007 Plans:

- Program transitions to new activities as noted in FY 2005 accomplishments.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

	FY 2005	FY 2006	FY 2007
OCEAN AND ATMOSPHERIC MODELING/PREDICTION AND EFFECTS	11,734	0	0

The battlespace environment represents a critical factor in Naval warfare and in any Naval operation, often resulting in a "go" or "no-go" decision for any contemplated action. The extent to which this environment can be modeled, through computational models used in making predictions of characteristics of the environment, provides an important means by which Naval forces can gain mastery over the environment and deny an adversary "home field" advantage. Consideration is routinely given to the nature of developments in Ocean and Atmospheric Modeling/Prediction and Effects to ensure that the technical efforts take appropriate account of developments in basic research and represent the most effective means of achieving progress toward the goals of the Ocean and Atmospheric Modeling/Prediction activity. Consideration is also routinely given to basic research developments in this active technology area that are ready for incorporation into this applied research program. This activity will enable Naval forces to have unprecedented knowledge of the battlespace and its environmental conditions, which is fully consistent with the SEA POWER 21 strategy.

The transition to a revised activities structure in this PE resulted in a 100% decrease in FY 2006 and FY 2007. FY 2006 and out activities are reflected elsewhere within this PE.

FY 2005 Accomplishments:

- Completed first tests of coupled global and regional aerosol prediction system with data assimilation. Efforts aimed to build on recent successes of the application of atmospheric modeling demonstrated in Operation Enduring Freedom.
- Completed techniques to provide scalable 3-D acoustic propagation model into Navy Oceangraphic and Atmospheric Master Library (OAML). (NRL)

The following projects transition to new activity Marine Meteorology in FY 2006:
- Continued developments in atmospheric effects on electromagnetics and electro-optics because of the central importance of electromagnetic and electro-optic propagation to many modern warfare systems. (NRL)
- Continued to develop methods for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect electromagnetic/electro-optic propagation.

The following projects transition to new activity Physical Oceanography in FY 2006:

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

- Continued the study of the effect of shoaling waves on ocean wave prediction. (NRL)
- Continued the development of techniques, software, and testing of a global relocation capability for ocean circulation models with a focus on the littoral ocean. (NRL)
- Continued developments of efforts in atmospheric and ocean model nowcast/forecast systems at a variety of scales (global, regional, semi-enclosed seas, local) including relocateable and nested models dependent on other priorities in this area. (NRL)
- Continued to employ ocean models to complete 3-D acoustic simulations of space-time coherence of the acoustic field, which is a primary characteristic related to detection performance of acoustic systems.
- Continued development in advanced on-board ocean models to maximize the on-board forecast capabilities available to the on-scene commander.
- Continued to extend current theory dealing with tidal variations in sound-speed to sound-speed events with strong range dependence. (NRL)
- Continued study of coastally buoyant jets using a combination of observations and numerical models. (NRL)
- Continued efforts in nested models to allow for a larger domain ocean model to set boundary conditions for a smaller domain model. Incorporated high-resolution nests into the Navy Coastal Ocean Model (NCOM). (NRL)
- Continued development of mass conserving baroclinic finite element models using discontinuous Galerkin methods. (NRL)
- Continued studies of the monitoring and evaluation of ocean currents and water mass properties near topographic control points in marginal seas. (NRL)
-Initiated effort in undersea persistent surveillance to provide detailed, real-time oceanographic information for sensing and sensor performance predictions.
- Initiated development of predictive capability of internal wave affects on the battlespace, including affects on acoustic transmission.
- Initiated effort in undersea persistent surveillance to provide detailed, real-time oceanographic information for sensing and sensor performance predictions.

FY 2006 Plans:

- Program transitions to new activities as noted in FY 2005 accomplishments.

FY 2007 Plans:

- Program transitions to new activities as noted in FY 2005 accomplishments.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

	FY 2005	FY 2006	FY 2007
NAVAL WARFARE SYSTEM-FOCUSED EFFORTS	10,355	0	0

This activity is the only applied research effort dedicated to determination of the impact of the natural environment on Naval warfare and Naval operations. As such, many questions about the impact of the natural environment on either operational systems or on Naval warfare systems under development and their performance become technical issues for this activity. The Littoral Zone (LZ) has been the natural environment of greatest interest. Aspects of this environment that greatly impact Naval warfare are the generally shallow waters of the LZ, the consequent closeness and physical significance of the ocean bottom, and the complexities inherent to potentially rapid changes of the ocean structure as well as the ocean bottom. Continual evaluation is given to the state of Naval warfare systems to ensure that technology development in the Naval Warfare System-Focused Efforts activity reflects the optimum choices for greatest impact of the work on Naval systems. This activity, through its focus on impact of the natural environment on Naval warfare systems, supports the Navy Transformation Roadmap strategy by exploiting knowledge of the environment to gain advantage over potential adversaries.

The transition to a revised activities structure in this PE resulted in a 100% decrease in FY 2006 and FY 2007. FY 2006 and out the activities are reflected elsewhere within this PE.

FY 2005 Accomplishments:

- Initiated and completed geoacoustic inversion techniques by verifying predictions of rough surface scattering theories with laboratory measurements. (NRL)
- Initiated and completed explosive placement pattern for air-dropped Mine Countermeasure (MCM) weapon systems using improved sediment shock physics models. (NRL)

The following efforts transition to new activity Coastal Geosciences/Optics/Biology in FY 2006:
- Continued innovative translator methods to apply mappings to xml request/response objects. (NRL)
- Continued to pursue techniques to allow determination of sediment microfabric and geotechnical properties and their exploitation in prediction of mine burial. (NRL)
- Continued development and testing of an underwater geo-magnetic noise model. (NRL)
- Initiated development of adaptive algorithms to improve MCM electro-optic sensor performance. (NRL)
- Initiated review of tools available to parse Web Services XML descriptions. (NRL)
- Initiated development of mapping functions to map the Advanced METOC Broker (AMB) schema to discovered Web

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

Services schema. (NRL)
- Initiated collaboration with the Naval Postgraduate School on METOC ontology development. (NRL)
- Initiated enhancement to clustering algorithm to cluster features in 3D (e.g., geospatial X,Y location plus color) and determined clutter density. (NRL)
- Initiated design of human subject experiments to test user performance as a function of clutter in various displays (e.g., nautical, meteorological, aeronautical). (NRL)

The following efforts transition to new activity Ocean Acoustics in FY 2006:
- Continued to develop ability to optimize 3-D sonar search path by incorporating environmental uncertainty into the acoustic propagation estimates. (NRL)
- Continued analysis of experimental data sets to quantify the impact of dynamic oceanography on acoustic ASW system performance. (NRL)
- Initiated development of an integrated hydrodynamic/acoustic propagation modeling capability for littoral regions to predict acoustic ASW system performance in dynamic environments. (NRL)

The following efforts transition to new activity Marine Meteorology in FY 2006:
- Continued development of techniques for analysis and exploitation of through-the-sensor technology for rapid environmental assessment in support of Sea Strike. (NRL)
- Continued further development of techniques for improving high-resolution environmental fields required for chemical/biological warfare. (NRL)

The following effort transitions to new activity Physical Oceanography in FY 2006:
- Continued developing environmentally sensitive, physics-based decision tools, and measures of effectiveness in predictive systems. (NRL)

FY 2006 Plans:

- Program transitions to new activities as noted in FY 2005 accomplishments.

FY 2007 Plans:

- Program transitions to new activities as noted in FY 2005 accomplishments.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

	FY 2005	FY 2006	FY 2007
MARINE METEOROLOGY	0	9,359	10,003

The marine atmosphere affects most aspects of Naval operations. This activity develops observing technologies, models, numerical weather prediction (NWP) systems and tactical decision aids (TDA) that describe the atmospheric environment and its impacts on naval sensors and operations. This activity focuses on uniquely marine aspects of atmospheric science such as air-sea interaction, coupled ocean-atmosphere modeling, electromagnetic (EM) and electro-optic (EO) propagation, coastal meteorology, tropical cyclone prediction, and the use of remote sensing to obtain quantitative observations of atmospheric properties. Aspects of the atmospheric environment of particular interest include near-surface phenomena that affect refractivity, marine boundary layer dynamics that affect clouds, rain, visibility and fog, and processes that control tropical cyclone structure, track, and intensity. Objectives of this activity are improved NWP systems and TDAs that provide nowcast and forecast skill at global, regional, and tactical scales for operational support, sensor and system development, and performance prediction.

The transition from other activities in this PE resulted in a 100% increase in FY 2006 and FY 2007.

FY 2005 Accomplishments:

- Funded in other activities noted in the FY 2006 plans.

FY 2006 Plans:

Efforts noted below transitioned from BSE Concept Enabler, Ocean and Atmospheric Modeling/Prediction and Effects, and Naval Warfare System-Focused Efforts.

ONR
- Continue developments in atmospheric effects on electromagnetics and electro-optics because of the central importance of electromagnetic and electro-optic propagation to many modern warfare systems.
- Complete development of methods for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect electromagnetic/electro-optic propagation.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

NRL
- Complete development of techniques for analysis and exploitation of through-the-sensor technology for rapid environmental assessment in support of Sea Strike. (NRL)
- Complete development of a technique for improving high-resolution environmental fields required for chemical/biological warfare defense. (NRL)
- Initiate application of predictability concepts to optimize use of new-generation satellite data to target observation selection for maximum forecast impact in military areas of interest. (NRL)
- Initiate exploitation of optimal methods for capturing uncertainty of environmental predictions on regional and local scales for reliability estimates of tactical parameters. (NRL)

ONR and NRL
- Initiate effort to optimize rapid environmental assessment using coupled air-sea systems to support multiple warfare and mission areas, with a particular emphasis on Special Warfare. (ONR and NRL)

FY 2007 Plans:

ONR
- Continue development of an electro-optic (EO) propagation model that accounts for the atmospheric effects of near-surface refraction, scintillation, aerosol extinction, illumination and target, background and sensor characteristics for incorporation into EO tactical decision aids and for supporting warfare systems development.
- Initiate development and validation of the Advanced Propagation Model (APM) to account for atmospheric effects on electromagnetic (EM) radiation, in particular, by the addition of the capability to describe HF radio frequencies.
- Initiate development of methods for determination of refractivity from clutter (RFC) as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect electromagnetic propagation.
- Initiate and complete the Rapid Transition Program (RTP) littoral warfare team adaptive sampling integration by combining bathymetry data from an the Remote Environmental Monitoring Units (REMUS) with other bathymetric data as input to a nearshore wave-hydrodynamic model for a nearshore nowcast. Forcing for nowcast is provided by the Distributed Integrated Ocean Prediction System (DIOPS).

NRL
- Continue application of predictability concepts to optimize use of new-generation satellite data to target observation selection for maximum forecast impact in military areas of interest. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

- Continue exploitation of optimal methods for capturing uncertainty of environmental predictions on regional and local scales for reliability estimates of tactical parameters. (NRL)

ONR and NRL
- Continue effort to optimize rapid environmental assessment using coupled air-sea systems to support multiple warfare and mission areas, with a particular emphasis on Special Warfare. (ONR & NRL)
- Initiate the development of a real-time meteorological and oceanographic battlespace characterization capability (NOWCAST) that collects, processes and exploits on-scene environmental data for Rapid Environmental Assessment (REA). The system will combine high-resolution atmospheric forecast information with 4-D data assimilation of on-scene observations (radar, satellite, conventional observations, etc) for customized display at time and space scales relevant for tactical operation support (ONR & NRL).
- Initiate the development of global and mesoscale aerosol/radiation models that account for the major sources (desert dust, sea spray, biomass burning, industrial pollution) of visibility degradation in the atmosphere and integrate with numerical weather prediction systems for an aerosol predictive capability than can support militarily relevant time and space scales (ONR & NRL).

	FY 2005	FY 2006	FY 2007
PHYSICAL OCEANOGRAPHY	0	12,970	12,971

The goal of this activity is to develop Naval tactical uses of knowledge of the physics of the ocean within the battlespace environment. This is achieved through the development of predictive models of the water mass structure, waves, currents, and air-sea interactions and developing measurement/observation technology. Other applications utilize knowledge of the interaction of the water column hydrodynamics and the acoustics to predict the undersea transmission characteristics and sources of uncertainty in these statistics. Utilizing knowledge of the ocean surface physics, the physical oceanography program seeks to exploit the combination of remotely sensed data, in-situ data, and adaptively sampled data to optimize predictions of ocean currents and water column structure. These predictions, custom databases, adaptive sampling schemes and data programs serve Anti-Submarine Warfare (ASW), Naval Special Warfare (NSW), Sea-Basing, and mine warfare needs.

The transition from other activities in this PE resulted in a 100% increase in FY 2006 and FY 2007.

FY 2005 Accomplishments:

- Funded in other activities noted in the FY 2006 plans.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

FY 2006 Plans:

Efforts noted below transitioned from BSE Sensors and Data, Ocean and Atmospheric Modeling/Predictions and Effects, and Naval Warfare System-Focused Efforts.

ONR
- Continue undersea persistent surveillance effort with field efforts using ocean gliders to provide water column structure influencing acoustic propagation and allowing adaptation of sampling locations for optimal inputs to ocean predictive models. (ONR)
- Continue to employ ocean models to complete 3-D acoustic simulations of space-time coherence of the acoustic field, which is a primary characteristic related to detection performance of acoustic systems. (ONR)

NRL
- Continue development of mass conserving baroclinic finite element models using discontinuous Galerkin methods. (NRL)
- Continue to extend current theory dealing with tidal variations in sound-speed to sound-speed events with strong range-dependence. (NRL)
- Complete the development of techniques, software and testing of a global relocation capability for ocean circulation models with a focus on the littoral ocean. (NRL)
- Complete study of coastally buoyant jets using a combination of observations and numerical models. (NRL)
- Complete the study of the effect of shoaling waves on ocean wave prediction. (NRL)
- Initiate the development of next-generation methods to estimate subsurface temperature and salinity from remotely-sensed surface and sparse in-situ observations (NRL)
- Initiate the development of a data assimilative nearshore modeling capability using measurements to guide hydrodynamic forecasts including data sampling strategies and model sensitivity to data. (NRL)
- Initiate the integration of hyperspectral imagery into underwater autonomous vehicles and derive river environmental properties through a combination of models and observations. (NRL)

ONR and NRL
- Continue studies of the monitoring and evaluation of ocean currents and water mass properties near topographic control points in marginal seas. (ONR and NRL)
- Continue developing environmentally sensitive, physics-based decision tools, and measures of effectiveness in predictive systems. (ONR and NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

- Continue to develop improved ocean wave prediction, especially shoaling waves, based on the extensive basic research measurement programs in this area over the past decade. (ONR and NRL)
- Continue development in advanced on-board ocean models to maximize the on-board forecast capabilities available to the on-scene commander. (ONR and NRL)
- Continue developments in atmospheric and ocean model nowcast/forecast systems at a variety of scales (global, regional, semi-enclosed seas, local) including relocateable and nested models dependent on other priorities in this area. (ONR and NRL)
- Continue efforts in nested models to allow for a larger domain ocean model to set boundary conditions for a smaller domain model. Incorporate high-resolution nests into the NCOM. (ONR and NRL)
- Continue development of predictive capability of internal wave affects on the battlespace, including affects on acoustic transmission. (ONR and NRL)

FY 2007 Plans:

ONR
- Continue undersea persistent surveillance effort with field efforts using ocean gliders to provide water column infrastructure influencing acoustic propagation and allowing adaptation of sampling locations for optimal assimilation into predictive ocean models. (ONR)
- Continue development of techniques to employ ocean models to perform complete 3-D acoustic simulations of space-time coherence of the acoustic field, enabling predictions of detection performance for acoustic systems. (ONR)
- Initiate and complete the development and implementation of new techniques for parameterizing fluxes of mass and energy across the air-sea interface in coupled ocean-atmosphere models, to improve operational predictions of the battlespace environment. (ONR)

NRL
- Continue development of mass conserving baroclinic finite element models using discontinuous Galerkin methods. (NRL)
- Continue to extend current theory dealing with tidal variations in sound-speed to sound-speed events with strong range-dependence. (NRL)
- Continue the development of next-generation methods to estimate subsurface temperature and salinity from remotely-sensed surface and sparse in-situ observations (NRL)
- Continue the development of a data assimilative nearshore modeling capability using measurements to guide hydrodynamic forecasts including data sampling strategies and model sensitivity to data. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

- Continue the integration of hyperspectral imagery into underwater autonomous vehicles and derive river environmental properties through a combination of models and observations. (NRL)

ONR and NRL
- Continue studies of the monitoring and evaluation of ocean currents and water mass properties near topographic control points in marginal seas. (ONR and NRL)
- Continue to develop improved ocean wave prediction, especially shoaling waves, based on the extensive basic research measurement programs in this area over the past decade. (ONR and NRL)
- Continue developments in atmospheric and ocean model nowcast/forecast systems at a variety of scales (global, regional, semi-enclosed seas, local) including relocateable and nested models dependent on other priorities in this area. Incorporate high-resolution nests into the NCOM. (ONR and NRL)
- Continue development of predictive capabilities for internal wave effects in the battlespace, including acoustic transmission and buoyancy impacts. (ONR and NRL)

	FY 2005	FY 2006	FY 2007
COASTAL GEOSCIENCES/OPTICS/BIOLOGY	0	11,584	11,054

The goal of this activity is to determine the sources, distribution, and natural variability (concentration and properties) of optically important matters in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare. Research investments in this activity support the development and testing of expendable and autonomous bioluminescence sensors, the continued development of extended range underwater imaging technologies, and algorithm development and testing for application to ocean color remote sensing from aircraft and space in order to characterize key features of the coastal battle space such as bathymetry, shallow-water bottom types, and the distribution of ocean water optical properties.

The transition from other activities in this PE resulted in a 100% increase in FY 2006 and FY 2007.

FY 2005 Accomplishments:

- Funded in other activities noted in the FY 2006 plans.

FY 2006 Plans:

Efforts noted below transitioned from BSE Concept Enablers, BSE Sensors and Data, and Naval Warfare System-

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

Focused Efforts.

ONR
- Continue bioluminescence sensor effort with emphasis on needs of the Special Warfare (SPECWAR) forces and NAVOCEANO, survey capabilities, and use of the bioluminescence sensors in joint field measurements with ocean sensors to determine persistence of the bioluminescence signal and the ocean factors controlling the persistence.
- Continue efforts to use space-based optical sensors as input for both active and passive optical MCM sensor performance prediction models.
- Continue development of innovative naval biosensors, biomaterials, and bioprocess technology.
- Continue programs for promising new biological and chemical sensors.
- Continue model development for diver visibility prediction in support of EOD and SPECWAR operations.
- Continue development of sensors to characterize diver visibility in support of EOD and SPECWAR operations.
- Complete programs in detection of fish by acoustic methods.
- Complete analysis of physics-based models for hyperspectral imaging of the ocean surface/near-surface to establish what information can be deduced about the optical properties of the ocean’s upper layers.
- Initiate engineering development and optimization of sea-floor sediment energy harvesting system for sustainable and autonomous powering of underwater sensor networks (coordinated with NRL Benthic Unattended Generator effort in this area).

NRL
- Continue design of human subject experiments to test user performance as a function of clutter in various displays (e.g., nautical, meteorological, aeronautical)(NRL).
- Continue to pursue techniques to allow determination of sediment microfabric and geotechnical properties and their exploitation in prediction of mine burial. (NRL)
- Continue development and testing of an underwater geo-magnetic noise model. (NRL)
- Continue development of adaptive algorithms to improve MCM electro-optic sensor performance. (NRL)
- Continue development of adaptive algorithms for image enhancement using an operational MCM electro-optic system and provide a demonstration. (NRL)
- Continue to refine algorithms that fuse sediment information extracted from operational sonars with historical sediment databases. (NRL)
- Continue development of gravity-based navigation by deploying a conventional gravimeter on a submarine. (NRL)
- Continue development of a Benthic Unattended Generator to power an autonomous ocean environmental profiler

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

and provide demonstration.
- Continue development of Web Services registry search algorithms (NRL).
- Continue innovative translator methods to apply mappings to xml request/response objects (NRL).
- Continue process to refine NPS's MetOc ontology (NRL).
- Complete studies of ionospheric scintillation phenomena using satellite-satellite measurements providing near global coverage using the Scintillation and Tomography Receiver in Space (CITRIS) instrument to the Space Test Program Satellite (STPSAT1) mission. (NRL)
- Complete work on Advanced Techniques for Net-Centric Warfare to create a Naval Advanced METOC Broker to reliably find and broker data from new and ad-hoc METOC data providers to the warfighter in an automated manner. (NRL)
- Complete algorithm developments for novel navigation and communications among multiple (Unmanned Undersea Vehicles (UUVs). (NRL)
- Complete a technique using hyperspectral and motion imagery in the LZ which offer new possibilities for exploitation based on previous investigation. (NRL)
- Complete field test of a shipborne LIDAR system for near surface environmental characterization. (NRL)
- Complete AMB system architectural design and complete development of functions to parse xml and to map AMB schema to Web Services schema (NRL).
- Complete enhancement to clustering algorithm to cluster features in 3D and determine clutter density (NRL).
- Initiate investigation into appropriate measures of reliability of data and data sources discovered by AMB (NRL).
- Initiate experiments (and data collection) to test user performance as a function of display clutter. (NRL)
- Initiate development of small satellite calibration targets to determine atmospheric drag due to neutral density via LIDAR remote sensing. (NRL)

FY 2007 Plans:

ONR
- Continue development and testing in situ bioluminescence sensors and mapping bioluminescent properties.
- Continue efforts to use space-based optical sensors as input for both active and passive optical MCM sensor performance prediction models.
- Continue development of bio-sensors, -materials, and –process technology.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

- Continue development of sensors and models to characterize and predict diver visibility in support of EOD and SPECWAR operations.

NRL
- Continue experiments and demonstrations to allow for enhanced human performance via improved and automated data displays. (NRL)
- Continue efforts to increase understanding of sediment properties for mine burial prediction. (NRL)
- Continue to develop and test undersea noise models to improve sensor prediction performance in the littoral zone. (NRL)
- Continue development of adaptive algorithms to improve mine counter-measures (MCM) electro-optic sensor and system performance and provide a demonstration. (NRL)
- Continue development of gravity-based navigation by deploying a conventional gravimeter on a submarine. (NRL)
- Complete development of Web Services registry search algorithms (NRL).
- Complete innovative translator methods to apply mappings to xml request/response objects (NRL).
- Complete process to refine NPS’s MetOc ontology (NRL).
- Complete investigation into appropriate measures of reliability of data and data sources discovered by AMB (NRL).
- Complete experiments (and data collection) to test user performance as a function of display clutter. (NRL)
- Complete development of small satellite calibration targets to determine atmospheric drag due to neutral density via LIDAR remote sensing. (NRL)

ONR and NRL
- Continue development of a Benthic Unattended Generator to power an autonomous ocean environmental profiler and provide demonstration. (ONR and NRL)

	FY 2005	FY 2006	FY 2007
OCEAN ACOUSTICS	0	5,418	4,999

This activity is dedicated to the determination of the impact of the natural ocean environment on acoustic wave phenomena in support of Naval undersea warfare and underwater force protection operations. This activity studies underwater acoustic propagation, scattering from ocean boundaries, and ambient noise issues that impact the development and employment of acoustic systems. The Littoral Zone (LZ) has been the ocean environment of greatest interest. Aspects of this environment, that greatly impact underwater acoustic

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

systems, are the shallow water included in the LZ, the consequent closeness and physical significance of the ocean bottom, and the complexities inherent to rapid changes of the ocean structure. The objectives of this program are met through measuring, analyzing, modeling and simulating, and exploiting ocean acoustic factors to gain advantage over potential adversaries using undersea acoustic systems. Results of this activity support acoustic sensor and system development, performance prediction, and tactical decision aids.

The transition from other activities in this PE resulted in a 100% increase in FY 2006 and FY 2007.

FY 2005 Accomplishments:

- Funded in other activities noted in the FY 2006 plans.

FY 2006 Plans:

Efforts noted below transitioned from Naval Warfare System-Focused Efforts.

NRL
- Continue to develop a method to optimize 3-D sonar search path by incorporating environmental uncertainty into the acoustic propagation estimates. (NRL)
- Continue development of an integrated hydrodynamic/acoustic propagation modeling capability for littoral regions to predict acoustic anti-submarine warfare (ASW) system performance in dynamic environments. (NRL)
- Complete analysis of experimental data sets to quantify the impact of dynamic oceanography on acoustic ASW system performance. (NRL)
- Initiate development of a tactical decision aid (TDA) that can predict the dynamic oceanographic characteristics of shallow-water internal waves and their effects on underwater acoustic signals. (NRL)

FY 2007 Plans:

NRL
- Continue to develop a method to optimize 3-D sonar search path by incorporating environmental uncertainty into the acoustic propagation estimates. (NRL)
- Continue development of an integrated hydrodynamic/acoustic propagation modeling capability for littoral regions to predict acoustic anti-submarine warfare (ASW) system performance in dynamic environments. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

- Continue development of a tactical decision aid (TDA) that can predict the dynamic oceanographic characteristics of shallow-water internal waves and their effects on underwater acoustic signals. (NRL)

	FY 2005	FY 2006	FY 2007
NATIONAL OCEANOGRAPHIC PARTNERSHIP PROGRAM (NOPP)	0	9,714	9,691

This activity focuses on U.S. Navy investments in the National Oceanographic Partnership Program (NOPP). NOPP, established by the U.S. Congress (Public Law 104-201) in Fiscal Year 1997, is a unique collaboration among 15 federal agencies involved in conducting, funding, or utilizing results of ocean research. NOPP's value to the Navy derives from the capacity of the partnership to enable and ensure multi-agency efforts where such collaboration enhances efficiency or effectiveness, and/or reduces costs. Major areas of investment by NOPP include: development of an integrated coastal ocean observation system and development of sensors, communications and data acquisition, storage and processing tools required to effect it; modernization of ocean research and observation infrastructure; and, marine mammal-related research.

The transition from other activities in this PE resulted in a 100% increase in FY 2006 and FY 2007.

FY 2005 Accomplishments:

- Funded in other activities noted in the FY 2006 plans.

FY 2006 Plans:

Efforts noted below transitioned from BSE Concept Enabler.

ONR
- Continue marine mammal program on noise mitigation.
- Continue real-time forecasting system of winds, waves and surge in tropical cyclones.
- Continue The Partnership for Advancing Interdisciplinary Global Modeling (PARADIGM).
- Continue Global Ocean Data Assimilation Experiment (GODAE).
- Continue Hybrid Coordinate Ocean Model (HYCOM).
- Complete the Multi-Disciplinary Ocean Sensors for Environmental Analyses and Networks (MOSEAN).

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

FY 2007 Plans:

ONR
- Continue marine mammal program on noise mitigation.
- Continue real-time forecasting system of winds, waves and surge in tropical cyclones.
- Continue The Partnership for Advancing Interdisciplinary Global Modeling (PARADIGM).
- Continue Global Ocean Data Assimilation Experiment (GODAE) including assessment of GODAE boundary conditions for use in coastal ocean predictions.
- Continue Hybrid Coordinate Ocean Model (HYCOM).
- Initiate wireless communications for the coastal ocean.
- Initiate new methods for detection of fish, fish populations and mapping of fish habitat.
- Initiate development of sensors for sustained, autonomous measurement of chemical or biological parameters in the ocean.

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
BIOLUMINESCENCE TRUTH DATA MEASUREMENT AND SIGNATURE DETECTION	963	0

Continued research into the development of affordable, compact, efficient sensors that allowed ease of deployment and permit the rapid measurement of bioluminescence in the world’s oceans in order to create a database for future research. Advances in basic research over several years on bioluminescence in the ocean have enabled the development of a fundamental understanding of the phenomena and the Navy operations that may be affected.

	FY 2005	FY 2006
CARBON NANOTUBE-BASED RADIATION HARD NON-VIOLATILE RAM	4,341	0

Effort supported developmental Carbon Nanotube-Based Radiation Hard Non-Volatile RAM.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

	FY 2005	FY 2006
COASTAL ENVIRONMENTAL EFFECTS	4,051	0

Effort supported next generation of technical capabilities to acquire, collect, detect and analyze contaminants in the coastal environment.

	FY 2005	FY 2006
COASTAL MASINT	0	4,200

This effort supports coastal MASINT research.

	FY 2005	FY 2006
CONTINUATION OF RESEARCH IN OCEAN TECHNOLOGY AND AUTONOMOUS MARINE SENSORS	0	4,800

This effort supports continuation of research in ocean technology and autonomous marine sensors research.

	FY 2005	FY 2006
EXTENDED CAPABILITY UNDERWATER OPTICAL IMAGING	963	0

Effort continued research into development of smaller, more energy efficient sensors for autonomous underwater vehicles with an enhanced ability to detect and identify man-made objects in support of mine and undersea warfare.

	FY 2005	FY 2006
INTEGRATED LITTORAL SENSOR NETWORK	963	1,800

The central goal of the Integrated Littoral Sensor Network was to integrate scientific resources and understanding so as to enable rapid and effective response to potential terrorist threats as well as to episodic natural or accidental hazards, such as severe storms, harmful algae blooms or toxic spills.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

Deliverables to the Navy were a portable suite of sensors, models and informatics techniques for detection, diagnosis, and predictions of manmade and natural water-borne pathogens and toxins in ports, bays and littoral waters.

	FY 2005	FY 2006
NEW JERSEY COASTAL OBSERVING SYSTEM	0	1,000

This effort supports the New Jersey Coastal Observing System.

	FY 2005	FY 2006
OCEANOGRAPHIC SENSORS FOR MCM/AUTONOMOUS MARINE SENSORS	2,412	0

Continued research into the development of small, low-power sensors to be used on small autonomous underwater vehicles designed for covert characterization of denied areas, thereby it gave the Navy a new capability in MCM operations.

	FY 2005	FY 2006
SOUTHEAST COASTAL OCEAN OBSERVING SYSTEM (SEACOOS)	4,822	1,625

FY 2005 - This effort continued funding for SEACOOS. It enhanced data access to significantly improve the understanding of atmospheric, oceanic and coupled behaviors in the southeastern U.S., Bahamas, northern Caribbean basin and in the surrounding larger-scale systems.

FY 2006 - This effort supports the Southeast Coastal Ocean Observing System.

	FY 2005	FY 2006
SURA COASTAL OCEAN OBSERVATION PROGRAM (SCOOP)	2,506	0

The Southeastern Universities Research Association (SURA) Coastal Ocean Observing Prediction (SCOOP) Program worked towards the goal of providing a national system for observing and predicting the myriad events that occur in America's vital coastal waters. The SCOOP proposed to take on the task of integrating diverse

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

systems at the national level. Deliverables were software modules for data transport and data translation, computing storage & services, numerous demonstrations, and program integration.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0601153N (Defense Research Sciences)
PE 0602114N (Power Projection Applied Research)
PE 0602123N (Force Protection Applied Research)
PE 0602235N (Common Picture Applied Research)
PE 0602271N (RF Systems Applied Research)
PE 0602747N (Undersea Warfare Applied Research)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0603207N (Air/Ocean Tactical Applications)
PE 0603271N (RF Systems Advanced Technology)
PE 0603747N (Undersea Warfare Advanced Technology)
PE 0603782N (Mine & Expeditionary Warfare Advanced Technology)
PE 0604218N (Air/Ocean Equipment Engineering)

NON-NAVY RELATED RDT&E:
PE 0602601F (Space Technology)
PE 0602784A (Military Engineering Technology)
PE 0603401F (Advanced Spacecraft Technology)

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602651M
PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
JOINT NON-LETHAL WEAPONS APPLIED RESEARCH	1,880	8,910	6,036	6,043	6,043	6,043	6,043

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program funds the applied research, study, assessment, and demonstration of technologies that could provide a non-lethal capability or target effect. Investment areas include applied research related to: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and counter-material missions; non-lethal acoustic and optical technologies; advanced non-lethal materials (including materials for vehicle/vessel stopping and advanced anti-traction materials); associated human effects and effectiveness for new non-lethal stimuli; injury potential and effectiveness of directed energy, electric stun, ocular, and acoustic based non-lethal technologies; and developing models of crowd behavior and dynamics. This program transitioned from Program Element (PE) 0602114N, Power Projection Applied Research by order of the Under Secretary of Defense for Acquisition, Technology, and Logistics, USD(AT&L), to a separate PE for Joint Non-Lethal Weapons Applied Research and established the Marine Corps as the executive agent for DoD Joint Non-Lethal Weapons RDT&E.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602651M
PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS APPLIED RESEARCH

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	1,880	6,000	6,000
Congressional Action	0	3,000	0
Congressional Undistributed Reductions/Rescissions	0	-90	0
Rate Adjustments	0	0	36
FY 2007 President's Budget Submission	1,880	8,910	6,036

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The primary objective of this Program Element is the development of technologies that lead to the next-generation of Non-Lethal Weapons. The program consists of a collection of projects that range from studies and analyses to the development and evaluation of feasibility demonstration models. Individual project metrics reflect the technical goals of each specific project. Typical metrics include both the effectiveness of the technology, human effects and effectiveness, and potential for compliance with policy and legislation. Overarching considerations include the advancement of related Technology Readiness Levels and Human Effects Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602651M PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS APPLIED RESEARCH
PROJECT TITLE: JOINT NON-LETHAL WEAPONS APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
JOINT NON-LETHAL WEAPONS APPLIED RESEARCH	1,880	5,910	6,036	6,043	6,043	6,043	6,043

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project funds the applied research, study, assessment, and demonstration of technologies that could provide a non-lethal capability or target effect. Investment areas include applied research related to: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and counter-material missions; non-lethal acoustic and optical technologies; advanced non-lethal materials (including materials for vehicle/vessel stopping and advanced anti-traction materials); associated human effects and effectiveness for new non-lethal stimuli; injury potential and effectiveness of directed energy, electric stun, ocular, and acoustic based non-lethal technologies; and developing models of crowd behavior and dynamics.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
JOINT NON-LETHAL WEAPONS APPLIED RESEARCH	1,880	5,910	6,036

FY 2005 Accomplishments:

- Initiated examination of target effects/characterization and assessed the resulting crowd behavior and effectiveness of non-lethal acoustic and optical (light stun/distract) technologies.
- Initiated investigation of the characteristics, optimization, and control of Laser Induced Plasma (LIP) phenomena for its non-lethal applications to both counter-personnel and counter-material missions. LIP is a phenomenon of some high energy, short pulse lasers that has several potential applications to produce or transmit non-lethal stimuli.
- Initiated evaluation of advanced non-lethal material technologies, such as new anti-traction materials, for advanced non-lethal weapons.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602651M PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS APPLIED RESEARCH
PROJECT TITLE: JOINT NON-LETHAL WEAPONS APPLIED RESEARCH

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Continue applied research currently being performed under the Joint Non-Lethal Weapon Directorate's (JNLWD's) Non-Lethal Technology Innovation Center (NTIC). The continued mission of the NTIC is to foster the free flow of appropriate science and technology information between the JNLWD and academia, industry, military, and other government entities.
- Initiate investigation of several advanced non-lethal material technologies for advanced non-lethal weapons by including engine suffocates, morphing materials for new non-lethal rounds or flight bodies, and new non-lethal nano-materials.
- Initiate investigation of human effects associated with high-energy counter-material and counter-personnel lasers including human effects from exposure to counter-material lasers' direct and scattered radiation and laser-induced plasmas from counter-personnel lasers.
- Initiate examination of specific non-lethal effects and effectiveness associated with the laser-induced plasma phenomenon.

FY 2007 Plans:

- Continue all efforts of FY 2006.
- Initiate refinement of directed energy weapon models through research into non-lethal phenomena and assessment of human effects and weapon effectiveness.
- Initiate exploration of the use of light and sound to produce non-lethal human effects, to include saccade motion, discomfort and disability glare, flash-blindness, and potential cognitive effects, with level of light/sound stimuli below hazardous levels.
- Initiate exploration of long range, wireless, extended duration electrically induced neuromuscular incapacitation. Investigations will include the development of appropriate metrics of dose response for various levels and characteristics of electrical stimulation.
- Initiate applied research in the development of counter-personnel and counter-material directed energy non-lethal weapons, including counter-vehicle and advanced active denial activities.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602651M PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS APPLIED RESEARCH
PROJECT TITLE: JOINT NON-LETHAL WEAPONS APPLIED RESEARCH

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
BIOLUMINESCENCE TRUTH DATA MEASUREMENT AND SIGNATURE DETECTION	0	1,000

This effort supports bioluminescence truth data measurement and signature detection research.

	FY 2005	FY 2006
ENHANCE THE OPEN SUBMARINE MODEL	0	1,000

This effort supports research to enhance the open submarine model.

	FY 2005	FY 2006
EXTENDED CAPABILITY UNDERWATER OPTICAL IMAGING	0	1,000

This effort supports extended capability underwater optical imaging research.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0603651M Joint Non-Lethal Weapons Technology Development
PE 0603851M Nonlethal Weapons

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
UNDERSEA WARFARE APPLIED RESEARCH	79,380	84,482	83,435	70,646	69,167	68,359	68,165

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All Navy applied research in undersea target detection, classification, localization, tracking, and neutralization is funded through this Program Element (PE). Technologies being developed within this PE are aimed at enabling Sea Shield, one of the core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new anti-submarine warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking, and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country’s current capital investment in surveillance, submarine, surface ship, and air ASW assets.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	84,325	71,362	85,857
Congressional Action	0	14,200	0
Congressional Undistributed Reductions/Rescissions	-65	-1,080	0
Execution Adjustments	-3,499	0	0
FY 2005 SBIR	-1,381	0	0
Program Adjustments	0	0	-2,042
Program Realignment	0	0	-590
Rate Adjustments	0	0	210
FY 2007 President's Budget Submission	79,380	84,482	83,435

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The overall metrics of applied research in undersea warfare are to develop technologies aimed at improving target detection, classification, localization, tracking, increasing attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments, countering enemy torpedoes, providing the ability to conduct long-range engagements, increasing weapons load-out, providing multi-platform connectivity, increasing endurance/survivability, and reducing size and power requirements.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
UNDERSEA WARFARE APPLIED RESEARCH	58,919	70,282	83,435	70,646	69,167	68,359	68,165

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All Navy applied research in undersea target detection, classification, localization, tracking, and neutralization is funded through this project. Technologies being developed within this project are aimed at enabling Sea Shield, one of the core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new ASW operational concepts that promise to improve wide-area surveillance, detection, localization, tracking, and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship, and air ASW assets.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
WIDE AREA ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE	19,134	27,523	42,877

Wide Area ASW Surveillance is focused on dramatically improving the capability to sanitize large areas relative to the capabilities of legacy ASW sensors. Efforts include the development of affordable off-board systems with associated processing and robust, high bandwidth communications links. The cornerstone of Wide Area Surveillance is the ability to rapidly distribute acoustic and non-acoustic sensors from air, surface, and sub-surface platforms as well as to develop long-endurance sensors and unmanned ASW vehicles. This activity represents a shift from traditional fixed surveillance systems to autonomous, networked-components, multi-static operation, and supported by passive/active signal processing all with the objective of increased detection capabilities.

The increases from FY 2005 to FY 2006 and FY 2006 to FY 2007 reflect the following: realignments of Future Naval Capabilities (FNC) program investments associated with the Sea Shield Enabling Capability (EC) into this

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

activity; and a realignment of funds associated with the Innovative Naval Prototype (INP)- Persistent Littoral Undersea Surveillance (PLUS).

FY 2005 Accomplishments:

- Continued development of Telesonar technologies to enable deployable system acoustic communications.
- Continued development of signal processing algorithms aimed at reducing clutter-generated false alerts.
- Continued development/improvement of multi-static signal processing techniques for systems employing coherent sound sources.
- Continued development of “intelligent” algorithms aimed at optimizing distributed multistatic sources/receivers.
- Continued development of an advanced node design for survivable sensors.
- Continued development of a non-traditional tracking system for deployment on undersea vehicles.
- Continued development of multistatic signal processing algorithms with controllable transmit waveform type and ping schedule to enable improved detection and tracking of threat submarines.
- Completed analysis of at-sea data to validate signal-processing techniques derived from acoustic time reversal concepts. (NRL)
- Completed development of high data rate multi-access communications technique in Underwater Acoustic Communications (ACOMMS) and provide a demonstration of its capability. (NRL)
- Initiated integration of a prototype system for undersea persistent surveillance.
- Initiated investigation of undersea persistent surveillance system performance through simulation and subsystem tests.
- Initiated development and testing of components of a prototype system for undersea persistent surveillance.
- Initiated testing of a non-traditional tracking system.
- Initiated analysis and modeling of high frequency underwater acoustic communications techniques between Unmanned Undersea Vehicles (UUVs) and demonstrate its capability. (NRL)
- Initiated efforts to develop an underwater intruder defense system, including comprehensive active and passive signatures from swimmers, harbor environment noise characteristics, and fiber optic array technology.(NRL)

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continued at-sea testing of the multistatic system components.
- Completed development and testing of a software baseline for in-buoy signal processing.
- Completed development of smaller, cheaper low-frequency active transducers for multistatic sonar systems.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

- Completed development of “field-level” processing for large numbers of Compact Deployable Multistatic Receivers.
- Completed Palantir Project Plan.
- Initiated concept feasibility study and initial design concepts for a non-acoustic surveillance system (Palantir).

FY 2006 Plans:

- Continue all FY 2005 efforts, less those noted as completed.
- Complete efforts to measure, quantify, and model reverberation and clutter from biologics and the seafloor and provide a prediction tool for multistatic active sonars. (NRL)
- Initiate planning for testing of advanced node designs and associated technologies.
- Initiate development of alternative active optical sources and sensor devices for Non-Acoustic ASW systems.
- Initiate development of tracking and classification algorithms for broadband Doppler sensitive waveforms for wide area surveillance.
- Initiate development of a prototype system for Persistent Littoral Undersea Surveillance (PLUS).

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all FY 2005 efforts, less those noted as completed.
- Complete at-sea testing of the multistatic system components. This effort transitions to PE 0603747N.
- Complete concept feasibility study and initial design concepts for a non-acoustic surveillance system (Palantir).
- Initiate design and development of Palantir sensor and data collection system and conduct a FY 2006 data collection exercise.
- Initiate experimental test planning for Palantir sensor.
- Initiate Deployable Autonomous Distributed System study of component feasibility to enable effective deployment, survival, and cost options. This effort transitions to PE 0603747N in FY 2007.

FY 2007 Plans:

- Continue all FY 2006 efforts, less those noted as completed or transitioned.
- Complete development of Telesonar technologies to enable deployable system acoustic communications.
- Complete testing of advanced node design and associated technologies.
- Complete development of multistatic signal processing algorithms with controllable transmit waveform type

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

and ping schedule to enable improved detection and tracking of threat submarines.
- Complete integration of a prototype system for undersea persistent surveillance.
- Complete investigation of undersea persistent surveillance system performance through simulation and subsystem tests.
- Complete development and testing of components of a prototype system for undersea persistent surveillance.
- Complete evaluation of undersea persistent surveillance system performance and trade-offs.
- Complete demonstration of a prototype system for undersea persistent surveillance.
- Complete development of a prototype system for PLUS. PLUS transitions to PE 0603782N (Mine and Expeditionary Warfare Advanced Technology) for advanced technology development beginning in FY 2008.
- Complete initial development of an underwater intruder defense system and provide a demonstration of a viable overall system concept. (NRL)
- Complete analysis and modeling of high frequency underwater acoustic communications techniques between UUVs and demonstrate its capability. (NRL)

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all FY 2006 efforts less those noted as completed.
- Continue Submarine Track and Trail applied research efforts for UUV technology in the areas of advanced undersea sensors, communications, and autonomy. This effort transferred from PE 0602114N due to EC realignments.
- Initiate an applied research effort to improve distributed system processing techniques and capabilities.
- Initiate the On-Demand Detection Classification and Localization effort focusing on the development of sensor and platform designs compatible with notional Concept of Operations.
- Initiate an effort to develop automation techniques for transition to various Littoral ASW distributed sensor systems.
- Initiate development of active sonar sensors and processing for wide area surveillance of deep ocean operating areas.
- Initiate development of signal processing and data fusion algorithms for deployed, bottom-mounted, distributed acoustic sensor fields.

	FY 2005	FY 2006	FY 2007
BATTLEGROUP ANTI-SUBMARINE WARFARE (ASW) DEFENSE	28,297	23,540	15,944

Battlegroup ASW Defense technology focuses on the development of platform-based sources and receivers aimed at denying submarines the ability to target grey ships. This technology area is primarily concerned with

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

detections inside 10 nm. Battlegroup ASW Defense integrates next-generation technologies, automatic target recognition, sensors that adjust to complex acoustic environments, and environmentally adaptive processing techniques. Battlegroup ASW Defense will enable smaller, lighter, and cheaper acoustic/non-acoustic arrays, large multi-line arrays, and submarine flank arrays (all with environmental adaptation capabilities).

The decreases from FY 2005 to FY 2006 and FY 2006 to FY 2007 reflect the completion and transition of efforts to budget activity 3 PEs as well as the realignment of FNC program investments into ECs. As a result of FNC reorganization, funding for each EC has been aligned to a budget activity 2 and budget activity 3 PE as appropriate. The FY 2007 funding level reflects the alignment of investments for the Sea Shield EC.

FY 2005 Accomplishments:

- Continued development of signal processing improvements for coherent tactical active sonar systems aimed at improving Detection, Classification, and Localization of small, slow moving submarines in shallow water.
- Continued investigation of synthetic aperture sonar techniques for improving target versus clutter classification performance.
- Continued development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Continued development and complete testing of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Continued design and development of underwater projectors using structural magnetostrictive materials.
- Continued development of baffled ring transducer technology.
- Continued development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features.
- Continued development of an acoustic/magnetic hybrid sensor.
- Completed evaluation of Reduced Diameter fiber-optic sensor to improve towed array reliability and transition to the NAVSEA Advanced Systems Technology Office, PE 0603561N.
- Completed development of sensors and algorithms to compensate for towed array performance degradation during maneuvers/turns and transition to the NAVSEA Advanced Systems Technology Office, PE 0603561N.
- Completed development of structural magnetostrictive materials to enable more rugged transducer designs.
- Completed investigations into time-reversal techniques to improve the performance of active sonar systems.
- Completed the development of a concept that automatically guides sonar operators through the complicated threat submarine detection, classification, and tracking process.
- Completed investigations of the feasibility of geo-acoustic parameter inversion and demonstrate using an operational Navy asset. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

- Initiated development of low cost, compact, combined acoustic sensor.
- Initiated development of advanced sonar signal processing algorithms that integrate target classification and tracking into a combined system for autonomous deployable sensor processing. The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continued development of signal processing and system control algorithms for the AN/WSQ-11 “Tripwire” torpedo protection system.
- Continued development of an AN/WSQ-11 “Tripwire” testbed for the testing of algorithms.
- Continued hardware component integration, testing; initiated further development to improve array functionality of the acoustic test bed in support of future passive sonar system designs.
- Completed preliminary Multi-Mode Magnetic Detection System (MMMDS) design and component-level development of air deployed magnetometer sensor technologies.
- Completed MMMDS development and installation of real-time noise reduction, detection, and tracking algorithms to enable data collection and performance evaluation.
- Initiated Adaptive Beamforming processing development.
- Initiated collection and analysis of MMMDS performance data. This effort transitions to PE 0603747N in FY 2006.
- Initiated evaluation of proposed MMMDS processing approaches and down-select to one approach. This effort transitions to PE 0603747N in FY 2006.
- Initiated collection of data at sea from torpedoes fired in salvoes of two and four for purposes of developing advanced automatic detectors and false alarm reduction techniques.

FY 2006 Plans:

- Continue all FY 2005 efforts, less those noted as completed.
- Continue collection of data at sea from torpedoes fired in salvoes of two and four for purposes of developing advanced automatic detectors and false alarm reduction techniques. Counter Torpedo Detection, Classification, and Localization (CTDCL) transitions to PE 0603123N (Force Protection Advanced Technology) in FY07.
- Complete development of baffled ring transducer technology. The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all FY 2005 efforts, less those noted as completed or transitioned.
– Continue hardware component integration, testing, and installation of acoustic array components in support of future array deployment.
- Complete Adaptive Beamforming processing development.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

FY 2007 Plans:

- Continue all FY 2006 efforts, less those noted as completed.
- Complete investigation of synthetic aperture sonar techniques for improving target versus clutter classification performance.
- Complete development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Complete development of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all FY 2006 efforts, less those noted as completed.
- Initiate a focused research study to evaluate sonar performance using the acoustic array testbed.

	FY 2005	FY 2006	FY 2007
COOPERATIVE ASW	1,171	738	766

Cooperative ASW technology developments enable ASW platforms to work together effectively to detect, classify, and localize very quiet undersea targets. Many of the tools required to achieve this objective were being developed as components of the Littoral Anti-Submarine Warfare Future Naval Capability under the heading of Integrated Anti-Submarine Warfare (IASW) in PEs 0602235N and 0603235N. The focus of this effort is to leverage those concepts and technologies previously investigated under IASW in order to develop technologies that enable the exchange and fusion of ASW sensor data among the technologies developed under Battlegroup ASW Defense, Wide Area ASW Surveillance, and Neutralization program areas.

The funding profile from FY06 to FY07 reflects the completion of the real-time data fusion effort.

FY 2005 Accomplishments:

- Continued development of technologies to automatically fuse tactical ASW sensor information to enhance the ASW portion of the Common Tactical Undersea Picture.
- Completed investigation into a flexible information/knowledge management architecture that can support several sonar systems and include land/air-based sensors.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

- Initiated the incorporation of estimates of environmental uncertainty into the fusion of sensor information.

FY 2006 Plans:

- Continue all FY 2005 efforts, less those noted as completed.
- Complete development of technologies to automatically fuse tactical ASW sensor information to enhance the ASW portion of the Common Tactical Undersea Picture.
- Initiate planning for an at-sea demonstration of real-time data fusion technologies.

FY 2007 Plans:

- Continue all FY 2006 efforts, less those noted as completed.
- Complete planning for and conduct at-sea technology demonstration of real-time data fusion technologies and analyze results.

	FY 2005	FY 2006	FY 2007
NEUTRALIZATION	10,317	18,481	23,848

Neutralization focuses on the development of enabling technologies for undersea weapons to counter threat submarines and surface vessels by increasing Probability of Kill and platform survivability. Weapon technology focus areas include: Explosives and Warheads, Guidance and Control (G&C), Multidisciplinary Systems Design & Optimization (MSDO) (comprising Simulation Based Design, Silencing, and Propulsion), Power Sources, Supercavitation, and Torpedo Defense (TD).

Demonstration Future Naval Capabilities projects included in the Neutralization effort (between FY05 and FY07) include: 1). Heavyweight Torpedo Technologies project (completed in FY05; subset of Torpedo Bridging Technology (TBT)), 2). the initiation of the Lightweight Torpedo Technology (LTT) project (initiated in FY05; subset of TBT), and 3). the initiation of the Compact Rapid Attack Weapon (CRAW) project (initiates in FY07).

The ultimate goal of the Neutralization effort is to develop modular and reduced sized undersea weapons based on common technology enablers (where possible), to provide revolutionary capabilities needed to fill Sea Shield Warfighter Capability Gaps, and enable new undersea weapon concepts of operations to rapidly transition to submarine neutralization/engagement in deep and shallow water under unique payload limitations posed by unmanned platforms, external stowage, and future Naval platforms.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

The funding profile from FY05 to FY06 reflects an increased naval emphasis on applied research and development of Lightweight Torpedo Technology (LTT) for the operational fleet. Additionally the development of LTT will sequentially feed into the Compact Rapid Attack Weapon (CRAW) initiating in FY07.

The increase from FY 2006 to FY 2007 reflects the reorganization of FNC program investments into ECs. As a result of this reorganization, the funding for each EC has been aligned to a budget activity 2 and budget activity 3 PE as appropriate. This activity reflects the alignment of investments for the Sea Shield EC.

FY 2005 Accomplishments:

- Continued development of improved threat models and torpedo system simulation capabilities under the Torpedo Enterprise Advanced Modeling and Simulation initiative.
- Continued development of technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons (examine experimentally, in water, the physics of interactions among multiple supercavitating projectiles in a projectile burst).
- Continued optimization of undersea weapons system design using MSDO with respect to constraints in cost and performance.
- Continued development of enhanced performance directed energy torpedo warhead technologies for Light Weight Torpedo Improvement and Compact Rapid Attack Weapon (CRAW) applications.
- Continued validation of computational models for torpedo lethality.
- Continued effort to conduct full ship validation effort for Explosion Response simulation code, using Dynamic System Mechanics Advanced Simulation (DYSMAS) Hydrocode (test plan developed, finite element ship model was completed, pretest simulations were conducted).
- Continued implementation of MSDO tools in hybrid propulsion and Weapons Silencing systems development.
– Continued development of high-speed supercavitating torpedo vehicle control and homing sensor. Continued to conduct experiments and tests on vehicle control concepts and homing sensors.
- Continued fourth quarter (of the fiscal year) explosive testing for warhead projects.
- Completed development of algorithms for coordinated behavior of groups of torpedo defense vehicles. Transition software algorithms to Next Generation Counter Measure (NGCM) in PE 0602123N.
- Completed technology development and in-water testing of the Weapon Silencing integrated motor/propulsor - Low Acoustic Motor Propulsor (LAMPrEy).
- Initiated development of a supercavitating 6.75-inch (or full-scale) vehicle with vehicle control devices and homing sensors.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

- Initiated feasibility investigations (including acoustic element construction) to test the ability of single crystal to operate at high field, high drive, and high duty cycle for both torpedo Tonpiltz transducer and broadband cylindrical projector applications.
- Initiated transition of undersea weapons system design tools techniques to Lightweight Torpedo (LWT), Anti-Torpedo Torpedo (ATT), and Next Generation Countermeasure. PEs 0602747N (FNC) and 0602123N (FNC).

The following efforts support the Sea Shield Future Naval Capability in the Littoral Anti-Submarine Warfare Mission Area:
- Continued application of MSDO tools probabilistic methods and uncertainty analysis for LWT design.
- Continued planning of a joint project agreement between the US and UK titled “Torpedo Guidance and Control (G&C): False Targets" and delivered a summary statement of intent to the Navy International Project Office.
- Completed development of TBT for weapons and combat systems to capitalize on connectivity between a HWT and submarine platform combat control including sensors.
- Completed development of TBT Weapons G&C innovative adaptive broadband signal processing algorithms that will improve a torpedo’s single-ping detection, classification, and localization.
- Completed transition of broadband signal processing and intelligent control technologies to PE 0603747N (R2 Activity: Neutralization) for integration and in-water demonstration during FY 2005.
- Initiated and completed development of a high fidelity Simulation Based Design model evaluation of weapon signal processing, Heavyweight Torpedo (HWT) tactical control technologies, and false alarm bottoms. Transition to PE 0603747N.
- Initiated feasibility investigations under LTT to quantify adjunct sensor configurations and signal processing approaches to enable positive discrimination of artificial targets at standoff ranges. This feasibility investigation is expected to result in five (5) new patent applications.
- Initiated (within the LTT project) sub-scale testing and scaling law determination of the directed blast warhead.
- Initiated LTT feasibility investigations to select the stealth and propulsion technologies for future integration as a low cost propulsion replacement for the Mk 54 lightweight torpedo.
- Initiated LTT feasibility investigations and selected geo-coordinate based navigation system technologies and connectivity methods (i.e. acoustic communications, fiber link) for future development of technologies for lightweight torpedo demonstration).
- Initiated data collection for lightweight torpedo broadband and counter-countermeasures in the harsh shallow water environment of the Shore Bombardment Area site off the Southern California Off-Shore Range using an experimental test vehicle fitted with a broadband Mk 54 array.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

FY 2006 Plans:

- Continue all efforts of FY 2005, less those noted as completed.
- Complete transition of undersea weapons system design tools techniques to LWT, Anti-Torpedo Torpedo (ATT), and Next Generation Countermeasure. PEs 0602747N (FNC) and 0602123N (FNC).
- Initiate fin and cavitator control, and integrate with controller for the supercavitating 6.75-inch vehicle.
- Initiate transition of LAMPrEy technology to DARPA Tango Bravo Program.
- Initiate torpedo design and optimization to support the external weapon stowage effort in DARPA Tango Bravo Program.
- Initiate data collection on a technology test-bed for surface ship close in torpedo defensive system using supercavitating projectiles

The following efforts support the Sea Shield Future Naval Capability in the Littoral Anti-Submarine Warfare Mission Area:
- Continue all efforts of FY 2005, less those noted as completed.
- Initiate LTT sensor package development to achieve integrated coherent broadband sonar and novel adjunct sensors homing and classification capabilities for LWT.
- Initiate LTT development of an advanced LWT directed charge warhead, multi-mode fusing, and sub-scale detonation testing.
- Initiate LTT advanced counter-countermeasure algorithm and tactics development for LWT.
- Initiate feasibility assessment of LTT to best utilize precision targeting and distributed sensors for weapon employment from high altitude and standoff range.
- Initiate development and integration of adjunct sensors into a lightweight torpedo sensor and design signal processing and data fusion techniques to improve target classification in areas of high contact density.
- Initiate a high fidelity weapon frequency model development effort to parallel adjunct sensor developments and provide accurate synthetic data for algorithm design and measurement. Transition to PE 0603747N.

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as completed.
- Complete LAMPrEy technology transition to DARPA Tango Bravo Program. PE 0603766E, Project NET-02.
- Complete development of improved threat models and torpedo system simulation capabilities under the Torpedo Enterprise Advanced Modeling and Simulation initiative.
- Complete transition of appropriate supercavitating vehicle control technology and control devices to DARPA

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

Underwater Express program.
- Initiate efforts that enhance undersea weapons G&C capabilities in autonomy, sensors, sensor processing, communication and networking by leveraging current, or contribute to developing, technologies for unmanned undersea vehicles (UUVs).

The following efforts support the Sea Shield Future Naval Capability in the Littoral Anti-Submarine Warfare Mission Area:
- Continue all efforts of FY 2006, less those noted as completed.
- Complete the joint project agreement between the US and UK titled “Torpedo Guidance & Control (G&C): False Targets" and investigate options for continued collaboration.
- Initiate development of a reduced size/weight CRAW for air deployment. This effort will include sensor, guidance and control, warhead, propulsion, and air frame integration tasks.
- Initiate use of design techniques for LWT using undersea weapons system design tools transitioned from PE 0602747N D&I in FY 2006.

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ACOUSTIC LITTORAL GLIDER SYSTEM	4,148	3,900

FY 2005 - Designed, built, and tested a prototype acoustic glider capable of operation in harsh littoral environments.

FY 2006 - This effort supports acoustic littoral glider system research.

	FY 2005	FY 2006
ATT (6.75-INCH DIAMETER) MULTI-MISSION WEAPON	4,919	1,700

FY 2005 - Continued optimization of signal processing and 6.75” weapon tactics used in ATT for offensive applications; updated the multi-mission ATT performance assessment software tools to address air dropped compact rapid attack weapon concept; and collected in-water data to evaluate proposed multi-mission guidance and control technologies.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

FY 2006 - This effort supports the ATT multi-mission weapon research.

	FY 2005	FY 2006
GALFENOL ALLOYS	1,156	0

Initiated development of metallurgical techniques to inexpensively manufacture Galfenol and other compositions of that general class of magnetostrictive materials. Galfenol is ductile (i.e., not brittle) and as such can be utilized in numerous applications that normal magnetostrictive and piezoelectric materials cannot be used.

	FY 2005	FY 2006
HIGH POWER, HIGH DUTY TRANSDUCERS	0	2,300

This effort supports high power, high duty transducer research.

	FY 2005	FY 2006
HIGH POWERED ULTRASONICS/SHIP WASTE TREATMENT	977	0

Continued most promising efforts of FY04. Initiated development of a small-scale prototype system for treating shipboard waste using high-powered ultrasonic technology.

	FY 2005	FY 2006
MAGNETORESTRICTIVE TRANSDUCTION RESEARCH	3,859	0

Continued the development and transition of Terfenol-D as an active magnetostrictive material for use in advanced underwater sonar transducer arrays. Expanded effort to include improvements to the corrosion resistance of the material.

	FY 2005	FY 2006
MEMS-IMU FOR AN ADVANCED UNDERWATER SENSOR	2,701	2,800

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

FY 2005 - Continued development of advanced manufacturing processes for MEMS and demonstrated their reliability and application in system prototyping and low volume output for various applications.

FY 2006 - This effort supports MEMS-IMU for an advanced underwater sensor research.

	FY 2005	FY 2006
MICRO-DETONICS FOR MINIATURE WEAPONS	2,701	0

Initiated development of the technology to enable fabrication of integrated Microelectromechanical Systems (MEMS) fuzing and micro-explosive initiators. Base materials and processes for in-situ fabrication of the micro-explosive material were investigated and developed. Micro-explosive materials resulting from candidate processing methods were analyzed and tested. The best processes was adopted and integrated into the MEMS fabrication sequence. The fabrication process, including the incorporation of micro-explosive material into a MEMS Fuzing/Safe & Arming chip, was demonstrated.

	FY 2005	FY 2006
PROTOTYPE DEMONSTRATION OF POINT DEFENSE UNDERSEA WEAPON	0	2,500

This effort supports prototype demonstration of point defense undersea weapon research.

	FY 2005	FY 2006
TOW CABLE SHAPE ESTIMATION	0	1,000

This effort supports tow cable shape estimation research.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0601153N (Defense Research Sciences)
PE 0602114N (Power Projection Applied Research)
PE 0602123N (Force Protection Applied Research)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

PE 0602435N (Ocean Warfighting Environment Applied Research)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0603114N (Power Projection Advanced Technology)
PE 0603123N (Force Protection Advanced Technology)
PE 0603506N (Surface Ship Torpedo Defense)
PE 0603553N (Surface ASW)
PE 0603561N (Advanced Submarine System Development)
PE 0603747N (Undersea Warfare Advanced Technology)
PE 0603758N (Navy Warfighting Experiments and Demonstrations)
PE 0604221N (P-3 Modernization Program)
PE 0604261N (Acoustic Search Sensors)
PE 0604784N (Distributed Surveillance Systems)

NON-NAVY RELATED RDT&E:
PE 0603763E (Marine Technology)
PE 0603739E (Advanced Electronics Technologies)
PE 0602702E (Tactical Technology)

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N
PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH	44,894	48,877	53,435	59,929	56,677	51,678	49,501

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Provides technologies for Naval Mine Countermeasures (MCM), Expeditionary Warfare, U.S. Naval sea mining, Naval Special Warfare (NSW), and Joint Tri-Service Explosive Ordnance Disposal (EOD). This program is strongly aligned with the Joint Chiefs of Staff Joint Warfighting Capability Objectives through the development of technologies to achieve military objectives with minimal casualties and collateral damage. Within the Naval Transformation Roadmap, this investment will achieve one of three “key transformational capabilities” required by “Sea Shield” as well as technically enable the Ship to Objective Maneuver (STOM) key transformational capability within “Sea Strike” by focusing on technologies that will provide the Naval Force with the capability to dominate the battlespace, project power from the sea, and support forces ashore with particular emphasis on rapid MCM operations. These efforts concentrate on the development and transition of technologies for the MCM-related and Urban Asymmetric/Expeditionary Warfare Operations (UAEO)-related Future Naval Capabilities (FNC) Enabling Capabilities (ECs). The Mine and Obstacle Detection/Neutralization efforts include technologies for clandestine and overt minefield reconnaissance, organic ship self-protection, organic minehunting and neutralization/breaching. The UAO effort includes critical warfighting functions such as Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), fires, maneuver, sustainment, etc. The Naval Special Warfare and Explosive Ordnance Disposal technology efforts concentrate on the development of technologies for safe near-shore mine detection, diver mobility and survivability, and ordnance disposal operations.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N
PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	47,544	49,520	54,839
Congressional Action	0	100	0
Congressional Undistributed Reductions/Rescissions	-36	-743	0
Execution Adjustments	-2,287	0	0
FY 2005 SBIR	-327	0	0
Program Realignment	0	0	-1,457
Rate Adjustments	0	0	53
FY 2007 President's Budget Submission	44,894	48,877	53,435

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The overall metrics of this applied research program are the development of technologies which focus on the Expeditionary Warfare challenge of speeding the tactical timeline and increasing safe standoff from minefields. Individual project metrics include the transition of 6.2 technology solutions into 6.3 advanced technology programs.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH	44,894	45,777	53,435	59,929	56,677	51,678	49,501

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project focuses on reducing the time involved in conducting Mine Countermeasures (MCM) operations and increasing safe standoff from minefields. It develops and transitions technologies for MCM-related and Urban Asymmetric/Expeditionary Warfare Operations (UAEO)-related Future Naval Capabilities (FNC) Enabling Capabilities (ECs). The MCM effort includes technologies for clandestine and overt minefield reconnaissance, organic ship self-protection, organic minehunting, neutralization/breaching and clearance. The Littoral Warfare effort includes critical warfighting functions such as Command, Control, Communication, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), fires, maneuver, sustainment, etc. The sea mining effort emphasizes technologies for future sea mines. The Naval Special Warfare and Explosive Ordnance technology efforts concentrate on the development of technologies to enhance diver capabilities including: safe near-shore mine sensing, mobility and survivability, and ordnance disposal operations.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT	2,048	449	0

Within the Naval Transformation Roadmap, this investment supports achievement of transformational capabilities of Ship to Objective Maneuver (STOM), a key capability within Sea Strike. This activity develops and demonstrates prototype capability to enable Naval Expeditionary Forces to influence operations ashore. The goal of Littoral Combat is the application of technologies to enhance the ability of the Navy/Marine Corps team to execute the naval portion of a joint campaign in the littorals. This activity considers all the critical functions of warfighting: Command, Control, Communication, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), fires, maneuver, sustainment, force protection, and training.

FY07 funding for this activity moved to PE 0602131M.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

FY 2005 Accomplishments:

-Continued development of advanced sensing algorithms to derive maps using digital imagery from airborne ISR assets to support expeditionary maneuver. (Previous efforts funded by PE 0602131M; FY 06 effort funded by PE 0602131M)
-Continued development of advanced weapon materials technologies. (Previous efforts funded by PE 0602131M and PE 0602236N; FY 06 effort funded by PE 0602131M)
-Continued development of expeditionary warfare decision support tools for Marine ground forces in support of STOM. (FY 06 effort funded by PE 0602131M)
-Initiated development of organic light emitting diode (OLED) display technology for shipboard use.

FY 2006 Plans:

-Continue design and development of rocket propelled grenade (RPG) defensive systems. (Previous efforts funded by PE 0602131M; FY07 effort continues in PE 0603640M.)
-Complete development of organic light emitting diode (OLED) display technology for shipboard use.

FY 2007 Plans:

Realigned to PE 0602131M.

	FY 2005	FY 2006	FY 2007
MINE/OBSTACLE DETECTION	25,717	28,459	32,294

This activity focuses on applied research to enable longer detection ranges and precise mine location with fewer false alarms in a variety of challenging environments. It supports Discovery and Invention (D&I) and Mine Countermeasure (MCM)-related FNC ECs. Efforts in Synthetic Aperture Sonar (SAS) technologies for longer range detection and classification of mine-like targets and magnetic gradiometer sensing and electro-optic (EO) technology for buried mine identification, and sensor integration onto Autonomous Underwater Vehicles (AUVs) are being addressed. EO sensor research develops algorithms to enable image processing for rapid overt reconnaissance from an Unmanned Aerial Vehicle (UAV). Other processing, classification and data fusion techniques to reduce operator workload, and a mine burial prediction “expert system” are also being developed. Efforts also support development of MCM Mission Modules for Littoral Combat Ships (LCS).

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

The funding profile from FY06 to FY07 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Mine Countermeasures Capacity Spiral 1 and 2; and Mine Countermeasures for Maneuver Spiral 1 and 2.

FY 2005 Accomplishments:

-Continued development of automated broadband physics-based target recognition algorithms.
-Continued the development of active electromagnetic sensing for short-range mine classification.
-Continued buried and proud mine target acoustic scattering measurements in the presence of bottom roughness using parametric and conventional sonars.
-Continued development of sensor systems for crawling vehicles, focusing on surf zone (SZ) mine detection and identification.
-Continued development of multi-static AUV-based minehunting integrating navigation, communication and sensor elements.
–Continued development of 12.75” UUV technology; conducted field testing.
-Continued development of a directional transponder and the development of an acoustic smart marker/pinger for reacquisition of very shallow water (VSW) mines.
-Continued development of rapid overt airborne reconnaissance (ROAR) active/passive EO image processing for detection of mines/minefields in VSW, SZ, and the beach zone (BZ).
-Continued to optimize the data input-output capabilities of the mine burial expert system and participate in a fleet exercise to demonstrate operational utility.
-Continued blazed array obstacle avoidance sonar effort - integrate onto a UUV for testing.
-Completed development of prototype broadband acoustic scattering sonar and integration onto a 21 inch AUV.
-Completed development of SAS motion compensation and beamforming algorithm for long-range, multi-path environment.
-Completed development of the Real-time Tracking Gradiometer (RTG) for classification of buried mines.
-Completed integration of RTG and Bottom Object Search Sonar (BOSS) prototype wing onto a 12.75” UUV and executed initial at-sea testing of combined sensors.
-Completed development of the Laser Scalar Gradiometer (LSG).
-Completed development of a Surf Zone Index (SZI) to predict sensor performance for both active and passive airborne EO systems.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

-Completed development of multi-platform fusion of AV-15 Kingfisher contact data via registration with those from the Mine Warfare Environmental Decision Aids Library (MEDAL) for improved mine detection and avoidance.

–Initiated effort to define the interface between MEDAL and the SQS-53C Integrated Peer Review (IPS) required to support transition of this registration capability.
-Initiated at-sea testing of prototype broadband acoustic scattering sonar focusing on multi-aspect mine classification/identification and characterization of clutter in various environments.
-Initiated the development of a low-cost, 12.75” UUV-based EO sensor for mine identification.
-Initiated development of long range, forward-looking Integrated Precision Underwater Mapping (iPUMA) sonar for small (12.75”) UUVs.
-Initiated development of data fusion algorithms for underwater electro-optic, magnetic and acoustic sensors to enhance probability of classification (Pc) and probability of identification (Pid) and reduce false alarm rate for proud and buried mine hunting.
-Initiated testing and evaluation of a common control language for AUVs.
-Initiated development of Over the Horizon (OTH) deployment concepts for UUVs.
-Initiated development of multi-platform fusion of data from high-resolution mine hunting systems (e.g. AN/AQS-20 and submarine-launched Mine warfare (MIW) UUVs via registration with those from the MEDAL for improved mine detection and avoidance.

Following are Discovery and Invention (D&I) efforts (ONR followed by NRL):
ONR
-Continued prototype Remote Sensing EO sensors for Tactical Unmanned Aerial Vehicle (TUAV) applications.
-Continued the development of multi-static acoustic sensing and processing for cooperating, unmanned vehicles.
-Completed an at-sea demonstration of Broadband SAS detection/classification of buried and proud mines at Sediment Acoustics Experiment 2004 (SAX04).
-Completed the development of underwater sensor prediction tools to support development, system design, and Tactical Decision Aids (TDA) efforts.
-Initiated evaluation of Littoral Remote Sensing (LRS) algorithm development requirements utilizing data streams available from national and organic sensors.
-Initiated design and development of broadband interferometric SAS.
NRL
-Continued development and testing of the Integrated Mine Burial Model and transition to the Naval Oceanographic Office (NAVOCEANO). (NRL)
-Completed analysis and reporting of scanning focused acoustic fields using time-reversal acoustics. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

-Initiated the primary sub-system design efforts to extend mine identification using acoustic color concept to longer ranges. (NRL)
-Initiated development of a concept of operations for generating geotechnical data inputs to the impact mine burial prediction model. (NRL)
-Initiated development of Ultrawideband (UWB) SAR imaging algorithms and design, and construction of SAR breadboard experimental system. (NRL)

FY 2006 Plans:

-Continue all efforts of FY05 less those noted as completed above.
-Complete, at-sea, UUV based testing of blazed array obstacle sonar.
-Complete at-sea testing of the RTG and BOSS wing prototype on a 12.75” UUV.
-Complete buried and proud mine acoustic scattering measurements in the presence of bottom roughness using conventional and parametric sonars.
-Complete development of sensor systems for crawling vehicles, focusing on SZ mine detection and identification.
–Complete development and field testing of 12.75” Unmanned Underwater vehicle (UUV) technology.
-Complete testing and evaluation of a common control language for AUVs.
-Complete development of a directional transponder and the development of an acoustic smart marker/pinger for reacquisition of VSW mines.
-Complete development ROAR active/passive EO image processing for detection of mines/minefields in Very Shallow Water (VSW), SZ, and the BZ.
-Demonstrate multi-platform fusion of SQS-53C Integrated Peer Review (IPS) contact data via registration with those from the Mine Warfare Environmental Decision Aids Library (MEDAL) for improved mine detection and avoidance.
-Initiate development of automatic mine detection and classification algorithms for integrated forward-looking iPUMA sonar and side-looking sonars.
-Initiate technology development for a Tactical UAV buried minefield detection sensor.

Following are D&I efforts (ONR followed by NRL):
ONR
-Continue all efforts of FY05 less those noted as completed above.
-Complete development of prototype Remote Sensing EO sensors for TUAV applications.
NRL

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

-Continue all efforts of FY05 less those noted as completed above.
-Complete development and testing of the Integrated Mine Burial Model and transition to NAVOCEANO. (NRL)
-Initiate analysis of at-sea experimental results and sediment poro-elastic and elastic propagation models to investigate the high frequency acoustic bottom interaction for various seafloor sediment properties. (NRL)
-Initiate the development of a numerical simulation capability for exploring synthetic aperture sonar (SAS) system sensitivities to seafloor sediment parameters. (NRL)

FY 2007 Plans:

-Continue all efforts of FY06 less those noted as completed above.
-Complete development of automated broadband, physics-based target recognition algorithms utilizing data collected by prototype sonar; and begin transition to Naval Sea Systems Command (NAVSEA) codes PMS-403 and PMS-495.
-Complete development of long-range, forward-looking sonar for small (12.75”) UUVs and begin at-sea testing.
-Complete the development of active electromagnetic sensor for short range mine classification.
-Complete development of data fusion algorithms for underwater electro-optic, magnetic and acoustic sensors to enhance Pc and Pid and reduce false alarm rate for proud and buried mine hunting.
-Complete the development of a low cost, 12.75” UUV based electro-optic sensor for mine identification, integrate onto a UUV, and conduct initial at-sea tests of sensor performance.
-Complete mine burial expert system and transition to the NAVOCEANO.
-Initiate large area search and survey based upon multiple, cooperating UUVs.
-Initiate technology development for MCM Mission Module systems for Advanced Flight LCS.

Following are D&I efforts (ONR followed by NRL):
ONR
-Continue all efforts of FY06 less those noted as completed above.
-Complete development of broadband interferometric SAS and begin at-sea testing.
-Continue evaluation of Littoral Remote Sensing (LRS) algorithm development requirements utilizing data streams available from national and organic sensors.
NRL
-Continue all efforts of FY06 less those noted as completed above.
-Complete evaluation of sediment poro-elastic and elastic propagation models to understand high-frequency acoustic-bottom interactions. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

	FY 2005	FY 2006	FY 2007
SPECIAL WARFARE/EOD	11,500	11,146	11,270

Naval Special Warfare (NSW) missions primarily support covert near-shore naval operations. The goal of this effort is to develop technology to increase the combat range and effectiveness of Special Warfare units. A major focus is to develop technologies to enhance the Sea-Air-Land mission of pre-invasion detection for clearance/avoidance of mines and obstacles in the VSW and SZ amphibious landing areas. Explosive Ordnance Disposal (EOD) operations typically occur in shallow, poor-visibility water, with high background noise, and in areas contaminated by a variety of unexploded ordnance (UXO). Advanced technologies are needed to gain access to areas contaminated by area-denial sensors and/or booby traps. Developed technologies will transition to the Joint Service EOD Program, the Naval EOD Program, or the DOD Technical Response Group. This activity includes applied research in sensor technology for NSW and EOD autonomous and handheld sonar systems to increase detection range and accuracy in harsh environments. Other efforts include mission support technology improvements for AUVs and human divers – such as communications, navigation and life support.

NRL investment in Special Warfare/EOD decreases in FY07.

FY 2005 Accomplishments:

ONR
-Continued development of dual-mode visible sensor for clandestine tracking of near-shore craft and other objects.
-Continued development of standoff detection and classification sensors for surface and buried UXO using multi-dimensional Electro-Magnetic (EM) methods.
-Continued development of technology to detect, monitor, and disrupt operation of explosive safe and arming Explosive Safe and Arming (ESA) devices.
-Continued development of low probability of intercept/low probability of detection (LPI/LPD) underwater communications.
-Continued development of AUV technologies for autonomous inspection of ship hulls.
-Continued development of robotic manipulators, actuators and control algorithms based on artificial muscle materials.
-Continued development of a diver heating system for swimmer delivery vehicle (SDV).
-Completed development of CO2 sensor.
-Completed development of a composite garment to provide diver insulation.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

-Completed development of man-portable impulse radar system for sense-thru-the-wall applications.
-Initiated analysis of NSW equipment signatures.
-Initiated development of an SDV low-observable periscope.
NRL
-Continued efforts in the design of a prototype deformable fin for AUVs. (NRL)
-Continued assembly of a prototype portable liquid crystal underwater imager by integrating the liquid-crystal cells with an acoustic lens. (NRL)

FY 2006 Plans:

ONR
-Continue all efforts of FY05 less those noted as completed above.
-Complete analysis of NSW equipment signatures.
-Complete development of standoff detection and classification sensors for surface and buried UXO using multi-dimensional EM methods.
-Initiate development of buried ordnance identification sensor.
NRL
-Continue all efforts of FY05.
-Complete prototype device of a portable liquid crystal underwater imager and perform a prototype demonstration. (NRL)

FY 2007 Plans:

ONR
-Continue all efforts of FY06 less those noted as completed above.
-Complete development of a diver heating system for SDV.
-Continue development of dual-mode visible sensor for clandestine tracking of near-shore craft and other objects.
NRL
-Continue all efforts of FY06 less those noted as completed above.
-Complete prototype of an AUV using a deformable fin by performing self-propulsion tests on a working vehicle and provide a demonstration. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

	FY 2005	FY 2006	FY 2007
MINE/OBSTACLE NEUTRALIZATION	5,441	5,538	9,673

Activity includes applied research to support selected Mine Countermeasures (MCM)-related Future Naval Capabilities (FNC) Enabling Capabilities (ECs) for rapid mine and obstacle neutralization and sea mine jamming techniques to increase surface ship safe standoff from threat mines. It includes various lethality, vulnerability and dispensing computational tools, models and assessments to support the various far-term Surf Zone (SZ) and beach zone (BZ) mine and obstacle breaching concepts.

The funding profile from FY06 to FY07 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Mine Countermeasures Capacity Spiral 2; Mine Countermeasures for Maneuver Spiral 1 and 2. The increase in FY 07 is due to expansion of Autonomous Mine Neutralization and Lane Navigation Efforts.

FY 2005 Accomplishments:

-Continued assessment of mine jamming using the advanced degaussing systems of the LPD-17 and DDG-76.
-Continued development of platform concepts for autonomous mine neutralization by AUVs.
-Continued assessment of dart dispenser concepts using advanced computational tools and engineering level models.
-Completed development of mine vulnerability database for SZ mines neutralized by pressure and impulse.
-Completed development of the mine vulnerability database for kinetic damage, shock, blast and thermal effects.
-Completed development of an advanced computational model to simulate guided bombs against SZ and BZ mines.
-Completed investigation of mine jamming effect on “dumb” mines.
-Initiated development of models to assess performance of bombs against mines in Very Shallow Water (VSW).
-Initiated development of advanced computational models for high speed water entry and penetration.
-Initiated development of advanced computational tools for predicting soil penetration by countermine darts.
-Initiated assessment of mine jamming using Impressed Current Cathodic Protection (ICCP) system on a steel-hulled combatant.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

FY 2006 Plans:

-Continue all efforts of FY05 less those noted as completed above.
-Initiate development of tool to assess mine jamming effectiveness on future ship designs.

FY 2007 Plans:

-Continue all efforts of FY06.
-Complete development of platform concepts for autonomous mine neutralization by AUVs.
-Complete assessment of dart dispenser concepts using computational tools and engineering level models.
-Complete development of models to assess performance of bombs against mines in VSW.
-Complete development of mine jamming effectiveness tool.
-Complete assessment of mine jamming using ICCP; and complete mine jamming effort with exit demonstration on representative mine field using a representative steel-hulled combatant ship.
-Initiate development of an expendable, autonomous underwater vehicle neutralizer, initially focused on neutralization of moored influence sea mines in very shallow water.
-Initiate development of stand-off, assault breaching warhead fuse to extend effectiveness of unitary warheads to greater water depths.
-Initiate development of precision navigation capability for targeting, safe navigation through assault lanes including lane marking.

	FY 2005	FY 2006	FY 2007
MINE TECHNOLOGY	188	185	198

This activity assesses advanced sea mine technologies to maintain expertise in this Naval Warfare area.

FY 2005 Accomplishments:

-Continued assessment of advanced sea mine technologies, focusing on remote control and warhead concepts for increased effectiveness.

FY 2006 Plans:

-Continue all efforts of FY05.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

FY 2007 Plans:

-Continue all efforts of FY06.

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
COORDINATED, HETEROGENEOUS TEAMS OF UNMANNED VEHICLES	0	2,100

This effort supports coordinated, heterogeneous teams of unmanned vehicles research.

	FY 2005	FY 2006
HYPERSPECTRAL IMAGER FOR THE COASTAL OCEAN	0	1,000

This effort supports hyperspectral imager for the coastal ocean research.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0601153N (Defense Research Sciences)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602435N (Ocean Warfighting Environment Applied Research)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))
PE 0603654N (Joint Service Explosive Ordnance Development)
PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)
PE 0604654N (Joint Service Explosive Ordnance Development)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

NON-NAVY RELATED RDT&E:
PE 0602712A (Countermine Systems)
PE 0603606A (Landmine Warfare and Barrier Advanced Technology)
PE 1160401BB (Special Operations Technology Development)
PE 1160402BB (Special Operations Advanced Technology Development)

D. ACQUISITION STRATEGY:

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N
PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	129,578	127,049	76,806	40,926	64,151	75,000	74,830
2911 POWER PROJECTION ADVANCED TECHNOLOGY	80,738	81,299	76,806	40,926	64,151	75,000	74,830
9999 CONGRESSIONAL PLUS-UPS	48,840	45,750	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program develops and demonstrates advanced technologies, including Directed Energy, for naval weapon systems, and Electric Warship. This Program Element (PE) includes elements of the following Future Naval Capabilities (FNCs); Time Critical Strike (TCS), Autonomous Operations (AO), and Knowledge Superiority Assurance (KSA). Within the Naval Transformation Roadmap, this investment will achieve one of four key transformational capabilities required by Sea Strike as well as technically enable elements of both Sea Shield and Force Net.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N
PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	135,758	82,538	84,043
Congressional Action	0	45,750	0
Congressional Undistributed Reductions/Rescissions	-110	-1,239	0
Execution Adjustments	-3,163	0	0
FY 2005 SBIR	-2,918	0	0
Program Adjustments	11	0	-3,170
Program Realignment	0	0	-4,225
Rate Adjustments	0	0	158
FY 2007 President's Budget Submission	129,578	127,049	76,806

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The metrics used for 0603114N programs are Technology Transition Agreements (TTA). TTAs are agreements between the Office of Naval Research and an acquisition program office to transition the 6.3 technology into an acquisition program.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2911 PROJECT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2911 POWER PROJECTION ADVANCED TECHNOLOGY	80,738	81,299	76,806	40,926	64,151	75,000	74,830

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Project includes elements of the following Future Naval Capabilities (FNCs): Time Critical Strike (TCS); Autonomous Operations (AO).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
PRECISION STRIKE TECHNOLOGY	36,866	51,263	47,247

This project focuses on the development of high speed (Mach 3 to Mach 4+) propulsion technologies supporting the development of strike weapons which significantly decrease the launch to engagement timeline. Investments under this activity were previously reported under the Time Critical Strike Future Naval Capability (FNC). This new activity breakout provides improved clarification of the overall investment scope.

Increase in FY 2006 and FY 2007 is due to a program adjustment for HyFly and NAI RATTLRS.

FY 2005 Accomplishments:

- National Aerospace Initiative Revolutionary Approach to Time-critical Long Range Strike (NAI RATTLRS): Initiated inlet/engine/nozzle design, integration and component testing. Initiated fabrication of long lead flow path hardware and ground testing of airframe and inlet configurations. Initiated design & risk reduction activities which lead to preliminary design.
- HyFly: Continued HyFly project efforts by conducting unpowered flights to demonstrate aircraft separation and booster powered flight. Completed freejet ground demonstration of engine performance.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2911 PROJECT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

FY 2006 Plans:

- NAI RATTLRS: Complete a preliminary design review of the proposed concept. Complete system critical design review. Fabricate safe separation flight test vehicles and flight test hardware. Accelerate technical development of individual components. Begin engine component fabrication assembly and testing, fabrication assembly and system check-out of the airframe and components, and fabrication of safe separation flight test vehicles and flight test hardware.
- HyFly: Complete two fully powered HyFly flights to demonstrate flight worthiness.

FY 2007 Plans:

- NAI RATTLRS: Complete final component demonstration and validation along with a critical design review. Conduct system checkouts and fabrication of flight demonstration vehicles. Perform a safe separation flight test.
- HyFly: Complete three fully powered HyFly flights to demonstrate Hypersonic and long rangeflight performance.
- Electromagnetic Gun (EM) Gun: Initiates procurement under this PE the first set of new capacitor banks to support the 32MJ muzzle energy demonstration. Additional sets will be purchased in FY08 and FY09 to provide a total of 100MJ of energy to the system. Conduct testing of initial barrel design components from the three vendors currently under contract to design and build the tactical barrel. Conduct system level testing of the energy storage and power delivery system through the rails of the railgun to ensure initial design will support the full scale power and current requirements in FY09 and FY10. Support testing of initial projectile concepts from two vendors currently under contract for projectile development.

	FY 2005	FY 2006	FY 2007
STRIKE AND LITTORAL COMBAT TECHNOLOGIES	28,168	8,735	21,051

The focus of this effort is on those technologies that will support the Naval Precision Strike Operations and provide the Navy of the future the ability to quickly locate, target, and strike critical targets. This activity includes support to the following Future Naval Capability (FNC) Enabling Capabilities (ECs): Advanced Naval Fires Technology, Hostile Fire Detection and Response, Dynamic Target Engagement & Enhanced Sensor Capabilities, and Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2911 PROJECT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

Decrease in funding from FY 2005 to FY 2006 is due to completion of initiatives. The funding profile from FY 2006 to FY 2007 reflects the reorganization of Future Naval Capabilities Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Advanced Naval Fires Technology Spiral 1, Hostile Fire Detection and Response Spiral 1, Dynamic Target Engagement & Enhanced Sensor Capabilities, and Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets.

FY 2005 Accomplishments:

- Advanced Gun Barrel & Targeting Technology (AGTT): Continued prior year efforts and began large scale gun material development and prototyping.
- Cruise Missile Real Time Retargeting (CMRTR): Completed program by performing full system test of V.3 sensor, completing V.4 sensor for low cost terminal seeker, integrated V.2, V.3 sensors with V.4, and performed V.4 subsystem tests.
- Precision Strike Navigator (PSN): Completed development of low cost precision Fiber Optic Gyro (FOG) Inertial Measurement Unit (IMU), and delivered updated high accuracy unit ready for evaluation.
- High-Speed Anti Radiation Missile (HSARM): Completed development, subsystem, and system level flight test demonstration of an advanced dual mode anti-radiation missile seeker for a ramjet-powered missile airframe. Classified effort will develop classified seeker technology for time critical targeting.
- Low-Cost Guided Imaging Rocket: Completed effort to develop a low-cost rocket system that uses an imaging seeker which can be used against a wide variety of targets.
- Ground Moving Target Indicator (GMTI) Capability: Began initial planning for a low-cost, single board radar system suitable for use on a long endurance Unmanned Air Vehicle (UAV).

FY 2006 Plans:

- AGTT: Take completed analytical modeling and scaled prototypes of advanced liner coatings and aluminum composite metal matrix material designs and complete fabrication of a full scale composite barrel test section.
- HSARM: Complete classified effort to develop seeker technology for time critical targeting.
- GMTI Capability: Continue effort to provide a low-cost, single board radar system suitable for use on a long endurance UAV.
- Ultra Endurance UAV: Initiate effort to provide affordable, high endurance platform/propulsion with

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2911 PROJECT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

Commercial Off the Shelf (COTS) and modified COTS components for persistent Intelligence, Surveillance and Reconnaissance (ISR), targeting, Bomb Damage Assessment/Bomb Damage Indication (BDA/BDI), and weapon delivery.

FY 2007 Plans:

- Advanced Naval Fires Technology (ANF): Initiate effort to reduce time delay from target acquisition to engagement through information sharing interfaces; accurate mobile, lightweight fire control systems and improved forward digital target acquisition and hand off. Specific tasks include: adaptive expeditionary maneuver warfare system, advanced gun barrel technology, advanced weapons material technology, indirect weapon aiming/pointing system size/weight reduction, Marine Air/Ground Task Force (MAGTF)/Joint fires information exchange connectivity and interoperability, Vertical Assault force lightweight computational interface capability, and universal fire control software for indirect weapon systems.
- Hostile Fire Detection and Response (HFDR): Develop technologies for hostile fire detection and active response capabilities to increase individual Marine and tactical level unit survivability and mobility. Specific efforts include: advanced ammo packaging, Electronic Warfare (EW) Integrated System for Small Platforms (EWISSP) and GUNSLINGER hostile fire detection and counter fire system.
- Dynamic Target Engagement & Enhanced Sensor Capabilities: Develop the capability to improve the processing of dynamic targets from 100 to 400 per day. Develop UAVs with increased endurance and support for more autonomous operations. Specific tasks include development of: decision support algorithms for dynamic target engagement, remote sensor fusion hardware for ground sensors, an ultra endurance UAV, and a GMTI radar system for use on UAVs.
- Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets: Provide products to discriminate targets from non-combatants and provide terminal guidance to engage targets that are operating in close proximity to noncombatants. The effort will develop advanced sensors, communications, and planning systems. Specific tasks include: the development of a Low-Cost Terminal Imaging Seeker (LCTIS).

	FY 2005	FY 2006	FY 2007
AUTONOMOUS OPERATIONS (AO)	15,704	21,301	8,508

The Autonomous Operations (AO) Future Naval Capability (FNC) activity aims to enhance the mission capability and operational utility of Naval forces by developing technologies that will dramatically increase the autonomy, performance, and affordability of Naval organic Unmanned Vehicle systems. By defining and focusing risk reduction overarching Intelligent Autonomy (IA) Science and Technology principles, transitional products

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2911 PROJECT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

will be developed in four areas: Unmanned Air Vehicles (UAV) Technology, which includes IA reasoning, technologies to enhance “see and avoid” capabilities, object identification, vehicle awareness, and vehicle and mission management; Unmanned Undersea Vehicles (UUV), which will demonstrate the technical feasibility for a UUV system to effectively search, detect, track and trail undersea threats while maintaining a robust communications link to enable appropriate command, control and transmission of collected data; Unmanned Ground Vehicles (UGV), which focus on the increasing utility of UGV systems in urban and littoral terrain to Marine Corps units; and UAV Propulsion, which will develop innovative propulsion and power technologies unique to Naval UAVs operating from surface combatants. This activity also contains a task from the Knowledge Superiority Assurance FNC.

Increase in funding from FY 2005 to FY 2006 is due to new initiatives. The funding profile from FY 2006 to FY 2007 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Marine and UxV Tactical Intelligence, Surveillance and Reconnaissance (ISR).

FY 2005 Accomplishments:

- IA Task: Continued in-water and simulation testing and demonstrating of dynamic replanning and autonomous vehicle control technologies. Conducted in-water demonstration of maritime situation awareness technology and simulation testing of dynamic replanning capability in a simulated warfare environment integrated with a Naval control station.
- UAV Technology: Continued work developing and performing simulation testing of sensors and sensor software and the development of multi-modal interface control. Developed and conducted testing of self-awareness sensor software and sub-system self-awareness sensors. Developed and tested several prototype Sonochute Launched UAVs (SL-UAV). Began integration of Landing Period Designator in the Bell Helicopter Eagle Eye ship landing simulator.
- UUV: Continued work developing and demonstrating undersea operations for Maritime Reconnaissance (MR) technologies, including transition of ISR Mast and advanced autonomy for 21-in UUV and autonomous docking station for small UUVs; continued development and testing of Undersea Search and Survey (USS) and Communications/Navigation Aids technologies.
- UAV Propulsion: Conducted ground test of the XTE-67/A1 UAV demonstrator engine with Naval-unique technologies and integrate with the enhanced next-generation commercial core and a Mach 3.5 capable expendable turbine engine for missile applications. This meets Integrated High Performance Turbine Engine Technology

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2911 PROJECT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

(IHPTET) phase III Joint Expendable Turbine Engine Concept goals and is a foundation for the Versatile Affordable Advanced Turbine Engine program.

FY 2006 Plans:

- IA Task: Complete testing and demonstration of dynamic replanning technologies including high-fidelity simulation of multiple classes of Naval unmanned vehicles in a simulated warfare environment, hardware, and in-water demonstrations. Continue testing and demonstration of multi-vehicle cooperation technologies.
- UAV Technology: Continue testing and demonstration of multi-modal interface control. Complete performing simulation testing of sensors and sensor software. Demonstrate the Sonochute Launched UAV from P-3 and continue system development. Integrate the Landing Period Designator into Eagle Eye and Firescout ship recovery systems and conduct demonstrations.
- UUV: Transition USS and Communication Navigation Aid products to Program Management Office-Explosive Ordnance Disposal and Office of Naval Intelligence (ONI-34); standup Submarine Track and Trail (STT) efforts in the areas of advanced undersea sensors, communications, and autonomy. TThe STT-B effort transfers to PE 0603747N in FY 2007 due to EC realignments.
- UAV Propulsion: Continue ground test of the XTE-67/A1 UAV demonstrator engine with naval-unique technologies and integrate with an enhanced next-generation commercial core and a Mach 3.5 capable expendable turbine engine for missile applications.
- Reconfigurable Surveillance UAV's (RSU): This effort will develop surveillance UAV's that can be reconfigured to support different packages in order to better provide protection to the warfighters. This activity will transition to PE 0602131M in FY 2007 due to the EC alignments.

FY 2007 Plans:

- IA Task: Complete testing and demonstration of multi-vehicle cooperation technologies including high-fidelity simulation of multiple heterogeneous Naval unmanned vehicles in a simulated warfare environment, hardware, and in-water demonstrations.
- UAV Technology: Complete testing and demonstration of multi-modal interface control.
- UAV Propulsion: Integrate power generation, distribution, prognostic and engine diagnostic and thermal management technologies on the WLE-67/A1 demonstrator engine and ground test. The propulsion system and associated technologies developed and demonstrated are applicable towards Joint-Unmanned Combat Air System (J-UCAS), and Broad Area Maritime Surveillance (BAMS) UAV.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2911 PROJECT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

C. OTHER PROGRAM FUNDING SUMMARY:
Navy RELATED RDT&E:
PE 0601153N Defense Research Sciences
PE 0602114N Power Projection Applied Research
PE 0602131M Marine Corps Landing Force Technology
PE 0602236N Warfighter Sustainment Applied Research
PE 0603123N Force Protection Advanced Technology
PE 0603782N Mine and Expeditionary Warfare Advanced Technology
PE 0603236N Warfighter Sustainment Advanced Technology
PE 0603790N NATO Research and Development
PE 0305204N Tactical Unmanned Aerial Vehicles (JMIP)
PE 0603502N Surface and Shallow Water Mine Countermeasures
PE 0603654N Joint Service Explosive Ordnance Development

NON-NAVY RELATED RDT&E: These PEs adhere to Defense S&T Reliance agreements with oversight provided by the Joint Director of Laboratories.
PE 0603285E Advanced Aerospace Systems
PE 0603709D8Z Joint Robotics Program
PE 0604709D8Z Joint Robotics Program
PE 0602203F Aerospace Propulsion
PE 0603216F Aerospace Propulsion and Power Technology
PE 0603205F Flight Vehicle Technology

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ADVANCED ELECTRIC DRIVES	1,453	0

This effort supported advanced electric drives.

	FY 2005	FY 2006
ADVANCED LIFTING BODY RESEARCH PROGRAM	4,824	0

This effort worked on issues arising from commercialization efforts coming from technology transfer.

	FY 2005	FY 2006
ADVANCED PANORAMIC SENSOR SYSTEMS FOR UAVs	0	1,250

This effort supports advanced panoramic sensor systems for UAVs reseach.

	FY 2005	FY 2006
ADVANCED TECHNOLOGIES FOR HIGH VELOCITY PARTICLE CONSOLIDATION	0	1,000

This effort supports advanced technologies for high velocity particle consolidation research.

	FY 2005	FY 2006
ADVANCED TECHNOLOGIES FOR PRINTED WIRING ASSEMBLY FABRICATION (PWB-HVPC)	3,278	0

This effort developed technologies and techniques to reverse engineer and repair multilayer printed circuit boards in Navy systems. Technologies included applying discrete sequence spread spectrum technologies for high resolution imaging of multilayer boards and laser assisted through hole and line metallization on boards.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
ARTICULATED STABLE OCEAN PLATFORM	966	1,000

FY 2005 - This effort developed a numeric tool for general articulated offshore platforms using simulation models previously developed.

FY 2006 - This effort supports articulated stable ocean platform research.

	FY 2005	FY 2006
BOW LIFTING BODY SHIP RESEARCH	0	6,000

This effort supports bow lifting body ship research.

	FY 2005	FY 2006
CENTER FOR COASTLINE SECURITY TECHNOLOGY	2,413	0

This effort developed and delivered visible and infrared sensors for harbor and coastal 24 hour all weather surveillance. Sensors were integrated on underwater, surface, and airborne unmanned vehicles as well as at the Naval Surface Warfare Center Carderock’s South Florida Test Facility along with attendant signal processing.

	FY 2005	FY 2006
COUNTERMINE LIDAR UAV-BASED SYSTEM (CLUBS)	0	1,000

This effort supports the Countermine LIDAR UAV-Based System (CLUBS)

	FY 2005	FY 2006
DP-2 VECTORED THRUST AIRCRAFT PROGRAM	7,256	3,900

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

FY 2005 - The test aircraft experienced a nozzle box failure in Nov 2004 which delayed testing. This effort repaired the affected systems and made additional vehicle improvements to increase hover performance and reliability: lightweight fuselage and wing, robust nozzle box and cascade mechanism. Testing resumed Jun 2005 to complete sustained controlled hover, in and out of ground effects.

FY 2006 - This effort supports the DP-2 Vectored Thrust Aircraft Program.

	FY 2005	FY 2006
EXCALIBUR UNMANNED COMBAT AERIAL VEHICLE	0	1,000

This effort supports the Excalibur unmanned combat aerial vehicle research.

	FY 2005	FY 2006
FREE ELECTRON LASER	2,121	0

This effort developed a capability to support the operation of a 5 MeV high current injector in the free electron laser facility. The task included processing and characterization of super conducting radio frequency cavities which were assembled in a cryounit for a systems test.

	FY 2005	FY 2006
HIGH OPERATING TEMPERATURE MIDWAVE INFRARED SENSORS	1,640	0

This effort developed and evaluated high performance medium wavelength infrared sensors of pixel size 320x240 with 640x480 goal for Navy, Marine Corps, and Army needs.

	FY 2005	FY 2006
HIGH-SPEED ANTI-RADIATION DEMONSTRATION (HSAD) - AIRFRAME/PROPULSION SECTION	4,822	5,000

FY 2005 - This effort matured key areas in the propulsion elements of the HSAD advanced anti-radiation guided missile. The effort better characterized the subsystem performance with additional testing, ramjet fuel development, insensitive munitions development, propulsion system optimization studies and propulsion

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

requirements development through operational/mission analysis.

FY 2006 - This effort supports HSAD-Airfram/Propulsion Section research.

	FY 2005	FY 2006
INFORMATION SHARING FOR ISR TARGETING AND ENGAGEMENT OF MOBILE TARGETS	0	1,500

This effort supports information sharing for ISR targeting and engagement of mobile targets research.

	FY 2005	FY 2006
INTERNAL ROTOR URBAN FLIGHT VEHICLE	0	500

This effort supports internal rotor urban flight vehicle research.

	FY 2005	FY 2006
LADAR	2,026	1,000

FY 2005 - This effort developed autonomous target recognition techniques, using ladar data that can be employed in an anti-ship role.

FY 2006 - This effort supports LADAR research.

	FY 2005	FY 2006
LONG WAVELENGTH ARRAY	0	3,500

This effort supports long wavelength array research.

	FY 2005	FY 2006
LOW COST TERMINAL IMAGING SEEKER	4,341	2,000

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

FY 2005 - This effort conducted additional modeling and simulation to improve characterization of the performance of the system and data collection and develop algorithms to improve the system performance in signal processing.

FY 2006 - This effort supports low cost terminal imaging seeker research.

	FY 2005	FY 2006
LOW-POWER MEGA-PERFORMANCE UAV PROCESSING ENGINES	1,928	0

This effort developed and delivered a Sequential Instruction Multiple Data (SIMD) integrated processing chip capable of 96 giga-loating point operations per second (GFLOPS) along with macro code software modules to process synthetic aperture radar onboard a small tactical unmanned aerial vehicle.

	FY 2005	FY 2006
LOW-POWER POLYMER BASED INFRARED TECHNOLOGY	0	1,500

This effort supports low-power polymer based infrared technology research.

	FY 2005	FY 2006
MULTI-FUNCTIONAL, HIGH-PERFORMANCE DUAL BAND IMAGING	1,640	0

This effort researched and developed sensor issues associated with multi-band infrared and radio frequency sensors for detection and track of asymmetric maritime threats.

	FY 2005	FY 2006
QUIET HIGH SPEED PROPULSION	3,473	4,800

FY 2005 - This effort developed an advanced hub-driven podded propulsor design for surface ship and submarine applications. The system has the attributes of reduced low-speed acoustic and electromagnetic signatures, is power dense, and provides high-speed platform performance.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

FY 2006 - This effort supports quiet high speed propulsion research.

	FY 2005	FY 2006
SHORT PULSE LASER DEVELOPMENT FOR MICROMACHINING APPLICATIONS	1,640	1,900

FY 2005 - This effort developed and delivered femtosecond lasers for micromachining of silicon and other materials.

FY 2006 - This effort supports short pulse laser development for micromachining applications research.

	FY 2005	FY 2006
SMART INSTRUMENT DEVELOPMENT FOR THE MAGDALENA RIDGE OBSERVATORY	0	3,500

This effort supports smart instrument development for the magdalena ridge observatory.

	FY 2005	FY 2006
SPACE SURVEILLANCE TECHNOLOGY	3,375	0

This effort supported space surveillance technology.

	FY 2005	FY 2006
STRUCTURALLY INTEGRATED LOW OBSERVABLE COATING SYSTEM	1,644	4,200

FY 2005 - This effort demonstrated light-weight, durable paint-replacement film development and manufacturing. The goal of this task was to reduce the cost, weight, and maintenance associated with paint replacement films for military aircraft.

FY 2006 - This effort supports structurally integrated low observable coating system research.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
TERAHERTZ DETECTION SYSTEM FOR IEDS/LANDMINES	0	1,200

This effort supports terahertz detection system for IEDS/Landmines research.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	171,710	165,611	61,504	49,709	49,962	51,027	51,322
2912 FORCE PROTECTION ADVANCED TECHNOLOGY	66,163	64,724	58,831	46,903	47,026	47,900	47,997
3049 FORCE PROTECTION	8,092	5,687	2,673	2,806	2,936	3,127	3,325
9999 CONGRESSIONAL PLUS-UPS	97,455	95,200	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. This program supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. This PE supports the Future Naval Capabilities (FNC) in the areas of Sea Shield and Cross Pillar Enablers. The goal of this program is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Surface Ship & Submarine, Hull, Mechanical & Electrical (HM&E), Missile Defense, Fleet Force Protection and Defense against Undersea Threats, and Emerging Threats activities all support FNC efforts.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	180,641	71,488	56,070
Congressional Action	0	95,200	0
Congressional Undistributed Reductions/Rescissions	-140	-1,077	0
Execution Adjustments	8,032	0	0
FY 2005 SBIR	-4,084	0	0
Program Adjustments	23	0	-2,234
Program Realignment	0	0	7,496
Rate Adjustments	0	0	172
Realignment of EM Railgun to PE 0602114N	-12,762	0	0
FY 2007 President's Budget Submission	171,710	165,611	61,504

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not Applicable

Schedule: Not applicable

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The overall goals of this applied research program are the development of technologies which focus on the warfighter and providing the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Overall metric goals are to transition the 6.3 advanced technology projects into acquisition programs. Each PE Activity has

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

unique goals and metrics, some of which include classified quantitative measurements.

Specific examples of metrics under this PE include:
- Improve performance of high speed craft to allow 4000 NM range in a craft capable of 50 kts maximum speed by FY 2007.
- Demonstrate improved performance of main propulsion electric motors and controllers (50% reduced weight and volume) by FY 2010.
- In-water successful demonstration of warhead lethality against specified threat at required Closest Point of Approach (CPA).
- Items included within the Missile Defense Activity description.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2912 FORCE PROTECTION ADVANCED TECHNOLOGY	66,163	64,724	58,831	46,903	47,026	47,900	47,997

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. This project supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. It supports the Sea Shield and Cross Pillar Enablers -- Future Naval Capabilities (FNCs). The goals of this project are to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability.

The funding profile from FY 2006 to FY 2007 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Fortified Position Security, Over-the-Horizon Missile Defense, Two-Torpedo Salvo Defense, Defense of Harbor and Near-Shore Naval Infrastructure Against Asymmetric Threats, Sea Based Missile Defense of Ships & Littoral Installations, Aircraft Integrated Self-Protection Suites, and Hostile Fire Detection and Response Spirals 1 and 2.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
SURFACE SHIP & SUBMARINE HULL MECHANICAL & ELECTRICAL (HM&E)	38,574	23,478	20,244

Activity includes: Signature Reduction, Hull Life Assurance, and Advanced Capability Electric Systems. Signature Reduction addresses electromagnetic (EM), infrared (IR), and acoustic signature tailoring, both topside and underwater. Hull Life Assurance addresses development of new structural system approaches for

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

surface ships and submarines, including the management of weapon effects to control structural damage and the improvement of structural materials. Advanced Capability Electric Systems area addresses electrical and auxiliary systems and component technology to provide improvements in system energy and power density, system operating efficiency, and recoverability from casualties. Advanced Damage Control Countermeasures addresses fire, smoke, and flooding detection using a volume sensor and the use of a hybrid water-mist for electronic space protection. This activity includes support to two FNC's Sea Strike and Cross Pillar Enablers.

Decrease in funding from FY 2005 to FY 2006 is due to the FY 2006 transition of further development of the electromagnetic gun technology to PE 0602114N.

FY 2005 Accomplishments:

- Continued development of diesel fuel reforming technology for molten carbonate and proton exchange membrane fuel cells.
- Continued development of advanced superconducting homopolar main propulsion motor with General Atomics.
- Continued development of superconducting synchronous main propulsion motor with American Superconductor.
- Continued technology efforts for reduced total ownership cost.
- Continued construction of Advanced Electric Ship Demonstrator (AESD).
- Continued development of electromagnetic gun technology, including focus on rail wear issues, energy storage, and pulsed power switching. Funding from PDM II will be applied to further develop electromagnetic gun technology, including focus on rail wear issues, energy storage, and pulsed power switching (transitions to PE 0602114N in FY 2006).
- Continued design and construction of 36.5 MW prototype HTS motor.
- Completed Quiet Electric Drive/submarine secondary propulsion unit (SPU).

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Complete construction of Advanced Electric Ship Demonstrator (AESD).
- Initiate advanced technology portion of on-board vehicle power system by fabricating and beginning component tests (transitioned from FY 2005 efforts under PE 0602123N).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as completed above.
- Transfer development of on-board vehicle power system technologies for future Marine Corps Battlefield Power System to PE 0603236N.
- Complete testing of superconducting synchronous main propulsion motor with American Superconductor.
- Initiate development of Integrated Damage Control Systems which includes Integrated Damage Control Communications and Advanced Magazine Protection System.

	FY 2005	FY 2006	FY 2007
FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS	12,849	23,320	25,418

Fleet Force Protection and Defense against Undersea Threats addresses efforts that include applied research for complementary sensor and processing technologies for platform protection and shipboard technologies to increase the survivability of surface ship and submarine platforms against torpedo threats.

The first major goal of this activity is to develop complementary sensor and processing technologies for 21st century warfighting success and platform protection. Current small platforms (both surface and airborne) have little or no situational awareness (SA) or self-protection against air, surface, and asymmetric threats. This activity will provide tactical aircraft (TACAIR) and other platforms with effective threat warning and self-protection. The technology areas specific to platform protection will develop individual or multi-spectral [electro-optic (EO), infra-red (IR), radio frequency (RF), electromagnetic (EM), visual, and acoustic] sensors and associated processing. To defend platforms from current and advanced threats in at-sea littoral environments and in port, these technologies must improve multi-spectral detection and distribution of specific threat information.

The Fleet Force Protection portion of this activity includes support to the FNC Enabling Capabilities for Aircraft Integrated Self-protection Suites, Intent Determination – EO/IR Enhancements, Proof-of-Concept for Non-lethal Approach, Advanced Electronic Sensor Systems for Missile Defense, and Hostile Fire Detection and Response Spirals 1 and 2.

The second major goal of this activity is to develop enabling technologies that will increase the

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

survivability of surface ship and submarine platforms against torpedo threats. Proposed technologies focus on defeating high priority threats including torpedoes (i.e. straight running, wake homing, acoustic homing, air dropped torpedoes, and salvoes of torpedoes). Technologies developed will minimize shipboard impact and require no shipboard organizational maintenance. Two major efforts are ongoing: 1) The Next Generation Countermeasure (NGCM) is a mobile adaptive acoustic countermeasure (CM) for defeating threat torpedoes; NGCM capabilities will include acoustic communication links to enable connectivity from each CM to other CMs (in the group) and to the host platform; and 2) The Anti-Torpedo Torpedo (ATT)/Tripwire provides technologies that enable an ATT to engage threat torpedoes detected by a surface ship towed sensor system. The ultimate goal is to develop technologies to enable a torpedo defense capability, including ship self-defense against salvo torpedo attacks, to fill the FNC Sea Shield Warfighting Capability Gap/Enabling Capability: Platform Defense against Undersea Threats. This will be accomplished by providing a capability to prevent a single salvo of two threat torpedoes fired at high value Naval platforms from hitting those platforms. Ultimately the efforts should deliver a netted set of decoys and an anti-torpedo-torpedo for use in defeating a 2-torpedo salvo attack against a surface or subsurface platform.

The funding increase from FY 2005 to FY 2006 reflects additional demonstration activity.

FY 2005 Accomplishments:

Sensors & Associated Processing -
- Continued the Integrated Defensive Electronic Countermeasures Pre-Planned Product Improvement (IDECM P3I) effort by laboratory demonstration of a coated carbon fiber cable that survives 27 times longer than Zylon under direct flame at temperatures >1800 degrees Fahrenheit.
- Continued the Electro-Optic/Infrared (EO/IR) Laser Jammer for Tactical Aircraft (TACAIR) effort by performing a laboratory demonstration of the upgraded multiband laser towards a goal of 5W in all bands.
- Continued the End User Terminal (EUT) effort by conducting a side-by-side laboratory demonstration of the Dismounted-Digital Automated Computing Terminal (D-DACT) including the integrated 256 color Organic Light Emitting Diode (OLED) display with a Liquid Crystal Display D-DACT.
- Continued the Shipboard EO/IR Closed Loop Self-Protection effort by demonstrating a pulse-gated visible receiver operating at 10kHz frame rate.
- Initiated and completed development of the conformal solid-state beam director for the EO/IR Laser Jammer for TACAIR.
- Initiated the Laser Detection and Ranging (LADAR) piece of the Distributed Aperture System (DAS) for

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

target imagery and identification. The LADAR build will be a low power breadboard model.

Underwater Platform Self-Defense -
- Continued open loop in-water data collection experiments to collect ATT one-on-one (1x1) sensor data for improving operations in the wake.
- Continued open loop in-water data collection efforts to evaluate the ATT two-on-two (2x2) salvo sonar technologies for emulated salvo threat during relevant engagement geometries.
- Continued in-tank tests evaluating the ability of ATTs to transmit and receive acoustic communication between vehicles.
- Completed open loop in-water data collection experiments to collect ATT one-on-one (1x1) sensor data of an emulated salvo threat during relevant engagement geometries.
- Completed requirements analysis for ATT warhead safe-and-arm inertial measurement unit.
- Initiated open loop in-water experiments to evaluate ATT salvo four-on-four (4x4) engagement technologies.

FY 2006 Plans:

Sensors & Associated Processing -
- Continue all efforts of FY 2005.
- Complete land based testing of optical design and data processing systems for DAS.
- Complete international effort to develop new and improved algorithms for DAS IRSTs to cope with at-sea environmental effects.
- Complete the Laser Detection and Ranging (LADAR) piece of the Distributed Aperture System (DAS) for target imagery and identification and DAS IRST testing.
- Initiate and complete the integration of the Gallium Arsenide (GaAs) transmitter with an ALE-55 sized Fiber-Optic Towed Decoy (FOTD) and onboard power supply for IDECM P3I.
- Initiate and complete the EUT effort by a field demonstration of the full capabilities of the integrated personal communications, situational awareness, and gunfire detection system including the Monocular Display with a super video graphics adapter (SVGA) resolution of 800x600 pixels.
- Initiate the Integrated EO/IR Self Protection Suite for Rotary Wing Aircraft effort by evaluation and demonstration of an uncooled missile warning system (MWS) sensor operating in the visible/near-infrared (500-1100 nanometer) spectral band.
- Initiate development work on improving imaging technologies (EO/IR/Laser) to support the Integrated Radar Optical Sighting & Surveillance (IROSS) Shipboard Protection System (SPS) Spiral for IROSS.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

Underwater Platform Self-Defense -
• Continue all efforts of FY 2005, less those noted as completed above.
• Complete open loop in-water data collection efforts to evaluate the ATT two-on-two (2x2) salvo sonar technologies for emulated salvo threat during relevant engagement geometries.
• Initiate closed loop in-water data collection experiments to collect ATT one-on-one (1x1) sensor data for improving operations in the wake.
• Initiate conduct of in-water demonstration of free swimming NGCM.
• Initiate in-water demonstration of NGCM controlled mobility.
• Initiate closed loop data collections to evaluate ATT two-on-two (2x2) salvo technologies for improving operations outside the wake.

FY 2007 Plans:

Sensors & Associated Processing -
• Continue all efforts of FY 2006, less those noted as complete above.
• Continue developing technologies to support the Intelligent Video Surveillance project which includes integration of object recognition and tracking algorithms, machine vision, and multiple networked video streams into different classes of EO/IR sensors. (Transferred into this PE from PE 0602131M in FY 2007.)
• Transfer completion of the Shipboard EO/IR Closed Loop Self-Protection effort to PE 0603271N. Completion efforts include a final at-sea demonstration of the Shipboard Integrated Electro-optic Defense System (SHIELDS) hardware, which consists of a Mid-wave IR (MWIR) camera operating in the 2-5um wavelength spectral band.
• Transfer development work on improving imaging technologies (EO/IR/Laser) supporting Integrated Radar Optical Sighting & Surveillance (IROSS) Shipboard Protection System (SPS) Spiral for IROSS to PE 0602131M.
• Complete the EO/IR Laser Jammer for TACAIR effort by performing laboratory demonstration of both the conformal solid-state beam director and common jam code countermeasure jamming capability by demonstrating a 95% jamming effectiveness for all Tier 1 and 2 IR threats.
• Complete the IDECM P3I effort by performing flight tests against single and multiple, simultaneous threats employing the complete system capabilities, including new towline capable of continuous operation at temperatures exceeding 1800 degrees Fahrenheit, 80W output continuous wave RF decoy, and Electronic Countermeasure (ECM) techniques.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

Underwater Platform Self-Defense -
• Continue all efforts of FY 2006, less those noted as complete above.
• Complete closed loop in-water data collection experiments to collect ATT one-on-one (1x1) sensor data for improving operations in the wake.
• Complete closed loop in-water data collection efforts to evaluate the ATT two-on-two (2x2) salvo sonar technologies for improving operations outside the wake.
• Complete evaluation of NGCM mobility capabilities by in-tank tests.
• Complete open loop in-water demonstration of ATT one-on-one (1x1) engagement in the wake.
• Complete conduct of in-water demonstration of free swimming NGCM.
• Initiate and complete clear-water preliminary demonstration of ATT salvo two-on-two (2x2) engagement.
• Initiate closed loop in-water experiments to evaluate ATT salvo four-on-four (4x4) engagement technologies.
• Initiate and complete demonstration of NGCM acoustic communication technologies and transition them to PMS415.
• Initiate and complete conduct of in-water demonstration of full duplex adaptive signal generation capability for NGCM.
• Initiate development of technologies to support the Underwater Threat Neutralization project which include a scalable low frequency continuous wave acoustic weapon for use against underwater asymmetric threats.
• Initiate in-tank experiments at Naval Undersea Warfare Center, Division Newport to evaluate NGCM group behavior technology.

	FY 2005	FY 2006	FY 2007
MISSILE DEFENSE (MD)	6,022	9,160	10,165

This activity describes Missile Defense Science and Technology (S&T) projects of the Sea Shield Future Naval Capability (FNC) program including:
• Advanced Area Defense Interceptor (AADI) S&T planning and data analysis effort for Navy-Marine Corps Air-Directed Surface-to-Air Missile (ADSAM) live firing demonstration at White Sands Missile Range in FY 2008. The metric for AADI is execution of an ADSAM demonstration by the Navy and Marine Corps that establishes the basis for further development of an operational Naval Integrated Fire Control/Counter-Air (NIFC-CA) capability.
• Distributed Weapons Coordination (DWC) open architecture combat system algorithms for theater air and

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

missile defense (TAMD) automated battle management aids (ABMA), including common threat evaluation (CTE) and preferred shot recommendation (PSR) functions that will enable fleet units to defend against air and missile attacks with increased effectiveness and efficiency. Metrics for DWC include (a) increased effectiveness of combat resources through a theater-wide threat evaluation process; (b) increased efficiency of weapons resources through weapon assignment and preferred shot recommendations considering TBMD and Area/Ship Defense capability operating simultaneously; and (c) reduced “free riders” (threats not fired at) due to ineffective use of resources (unengaged targets) by 50% (threshold) 80% (objective). Transition to acquisition in FY 2007.

- Distributed Sensor Coordination (DSC) algorithms for airborne sensor management in ADSAM and multi-threat air defense engagements. The metric for DSC is effective coordination of airborne sensor resources to support NIFC-CA capability, evaluated using laboratory Monte Carlo simulations within simulated stressing air defense environments. Transition to acquisition in FY 2008.
- Littoral Affordability (classified program). Metrics for this project are classified. Transition to acquisition in FY 2006.
- Naval Interceptor Improvements (NII) technology upgrades for STANDARD Missile 6 (SM-6) Block II future TAMD missile. The metrics for this new project will be defined in a transition agreement to be signed with the Navy acquisition customer upon project initiation in 2007 for an enhanced performance envelope for engaging advanced theater missiles in terminal phase while meeting or exceeding required performance against modern air threats. Transition anticipated in FY 2011.

Funding increase in FY 2006 is due to acceleration of DWC efforts. Funding increase in FY 2007 is caused by the addition of the new NII project.

FY 2005 Accomplishments:

- Continued AADI ADSAM demonstration planning and coordination efforts.
- Continued Littoral Affordability effort (classified program).
- Continued development of DSC algorithms and operational concept for TAMD sensor management.
- Continued testing and demonstration of DWC combat system algorithms developed under PE 0602123N.

FY 2006 Plans:

- Continue AADI, DSC and DWC efforts of FY 2005.
- Complete Littoral Affordability effort (classified program).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

FY 2007 Plans:

- Continue AADI planning and coordination for FY 2008 Navy ADSAM live-fire demonstration.
- Continue testing and demonstration of DSC algorithms.
- Complete testing and demonstration of DWC algorithms.
- Initiate NII project.

	FY 2005	FY 2006	FY 2007
HIGH SPEED CRAFT TECHNOLOGY	8,718	8,766	3,004

X-Craft is envisioned as an S&T platform designed for Littoral Combat Ship (LCS) risk reduction and mission module demonstration. A high-speed, all-aluminum catamaran, it displaces 1400 tons at full load. Performance requirements are 50 knots at combat load (about 1200 tons), 40 knots in sea state 4, and a 4000 nautical miles range without replenishment. It will be capable of landing two helicopters up to the size of SH-60R, transporting and operating autonomous vehicles, and carrying several reconfigurable mission modules in standard Twenty-foot Equivalent Unit (TEU) boxes. The crew will be minimal and the vessel will be built to commercial American Bureau of Shipping (ABS) standards.

Decrease of funding in FY 2007 is due to the completion of the X-Craft.

FY 2005 Accomplishments:

- Continued development of drag reduction and lifting body technology on an alternative platform using lifting bodies. Full-scale sea trials scheduled late FY 2005.
- Completed construction of LSC(X) and delivered to fleet.
- Initiated efforts to install lifting body and drag reduction systems on alternative high speed platforms.
- Initiated and completed certification testing of the X-Craft.

FY 2006 Plans:

- Complete sea trials and produce report on technology developments.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

• Initiate further development of drag reduction and lifting body technology on additional alternative platforms. Support demonstration and evaluation of lifting body hull forms.

FY 2007 Plans:

• Continue development of drag reduction and lifting body technology and lifting body hull forms.

C. OTHER PROGRAM FUNDING SUMMARY:
RELATED RDT&E:

NAVY RELATED RDT&E:
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0206313M (Marine Corps Communications Systems)
PE 0601153N (Defense Research Sciences)
PE 0602123N (Force Protection Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602235N (Common Picture Applied Research)
PE 0602271N (RF Systems Applied Research)
PE 0603235N (Common Picture Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603561N (Advanced Submarine System Development)
PE 0603563N (Ship Concept Advanced Design)
PE 0603564N (Ship Preliminary Design and Feasibility Studies)
PE 0603609N (Conventional Munitions)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))
PE 0604307N (Surface Combatant Combat System Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0604558N (New Design SSN)

NON NAVY RELATED RDT&E: Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 3049 PROJECT TITLE: FORCE PROTECTION

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
3049 FORCE PROTECTION	8,092	5,687	2,673	2,806	2,936	3,127	3,325

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Includes funds to develop and demonstrate advanced technologies that support platform self-protection. The new capabilities include the areas of all-weather, day/night protection of naval platforms and forces against all weapon threats, counter-stealth, and countermeasures. Demonstrate capabilities that support the ability to prevent or control platform damage while preserving operational capability. Hull life assurance addresses development of new structural system approaches for surface ships and submarines, including the management of weapons effects to control structural damage and the improvement of structural materials. Distributed intelligence for automated survivability addressees both the basic technology of automating damage control systems, as well as, distributed auxiliary control with self-healing capability. Realignment of the FNCs has resulted in Force Protection efforts to be included in the FNC Sea Shield. The efforts in this project will focus on protection of Naval Installations beginning in FY 2006. Other efforts (water-mist and volume sensor work) will move to PE 0603123N Project R2912 in FY 2006.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
EMERGING THREATS	8,092	5,687	2,673

This activity includes: Efforts in hull life assurance and survivability. It addresses the management of weapon effects to control structural damage and the improvement of structural materials. Advanced technologies developed, critical to protecting naval installations, will provide seamless full spectrum protection against asymmetric terrorist attack by improving the ability to: sense developing and immediate threats; shape our responses through improved situational awareness and decision making; shield personnel, mission critical facilities, infrastructure, and operating fleet assets; maintain essential functions; and sustain and restore critical services in the aftermath of an incident. Technologies developed will also seek

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 3049 PROJECT TITLE: FORCE PROTECTION

to reduce the required manpower and skill levels devoted to the force protection mission.

FY 2005 Accomplishments:

- Continued development of lower cost/higher performance Force Protection sensors and automated detection algorithms, and decision support tools.
- Completed development of real-time volume sensor by verifying algorithms.
- Completed intermediate-scale testing of hybrid water-mist system.
- Completed data collection and field test of volume sensor.
- Initiated and completed validation of full scale ship test performance of the real-time volume sensor on ex-USS Shadwell.
- Initiated and completed validation of full-scale ship performance trials of hybrid water-mist system on ex-USS Shadwell.

FY 2006 Plans:

- Continue all efforts of FY 2005, less those noted as completed above.
- Initiate Shipboard EO/IR Closed Loop Self Protection efforts.
- Initiate development of lower cost/higher performance Force Protection sensors, automated detection algorithms, and decision support tools.

FY 2007 Plans:

- Continue all efforts of FY 2006.
- Transfer the Shipboard EO/IR Closed Loop Self Protection efforts to PE 0602271N and 0603271N in FY 2007.
- Initiate interim demonstration of prototype Force Protection sensors.
- Initiate development of intrusion/incident response countermeasures for Force Protection.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0601153N (Defense Research Sciences)
PE 0602123N (Force Protection Applied Research)
PE 0602235N (Common Picture Applied Research)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 3049 PROJECT TITLE: FORCE PROTECTION

PE 0603235N (Common Picture Advanced Technology)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603561N (Advanced Submarine System Development)
PE 0603563N (Ship Concept Advanced Design)
PE 0603564N (Ship Preliminary Design and Feasibility Studies)
PE 0604558N (New Design SSN)
PE 0604561N (SSN-21 Developments)

NON NAVY RELATED RDT&E: Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
AC SYNCHRONOUS HIGH TEMPERATURE SUPERCONDUCTOR (HTS)ELECTRIC MOTOR	3,381	0

Continued manufacture of 36.5MW motor. Completed fabrication of rotor, stator, and frame. Procured load device and began test preparations.

	FY 2005	FY 2006
ADVANCED DEVELOPMENT AND DEMONSTRATION OF ELECTRIC ACTUATOR TECHNOLOGY	964	0

Initiated efforts including testing, validating performance, and establishing the range of possible shipboard applications of a quarter-scale actuator.

	FY 2005	FY 2006
AFFORDABLE, INTERMEDIATE MODULUS COTS CARBON FIBER QUALIFICATION PROGRAM FOR AIRCRAFT AND MISSILES	969	0

Initiated the qualification of intermediate modulus carbon fibers for use in polymer reinforced composite components for applications in JSF and Global Hawk, JUCAV and the F18.

	FY 2005	FY 2006
AGILE PORT AND HIGH SPEED SHIP TECHNOLOGY	4,825	4,500

FY 2005 - The Strategic Mobility-21 program is separately called out for FY 2005 but is a continuation of some FY 2004 work in Agile Port Technology. Addressed the development and utilization of a candidate inland port facility (Victorville) operating in conjunction controlled military and commercial cargo movement operations. The program will further involve both military and commercial port and terminal systems in the Southern California region. Developed the supporting architectures for the comprehensive plan developed as part of the FY 2004 effort. The Strategic Mobility 21 program for FY 2005 is presently being further defined and drafted

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

for approval and operational contracting in 2005 in conjunction with an Operational Concept Document that is in development with USMC and USA guidance and related FY 2004 Agile Port funding.

FY 2006 - This effort supports agile port and high speed technology research.

	FY 2005	FY 2006
AT-SEA DECONTAMINATION PLATFORM DEVELOPMENT AND CONCEPTUAL DESIGN	964	1,000

FY 2005 - Initiated a feasibility assessment of potential advanced ship decontamination system designs that could be used while at-sea including the predicted decontamination success rates for various Chemical/Biological/Radiological Warfare constituents, anticipated costs for forward fit and backfit onto Navy ships, and development of an optimum system design for Navy ships.

FY 2006 - This effort supports at-sea decontamination platform development and conceptual design research.

	FY 2005	FY 2006
AUTONOMOUS TECHNOLOGIES IN SUPPORT OF SEA POWER 21	0	1,700

This effort supports reasearch of autonomous technologies in support of sea power 21.

	FY 2005	FY 2006
AVIATION GROUND ADVANCED TECHNOLOGY	967	1,300

FY 2005 - Continued development and demonstration of the Aviation Ground Navigation System (AGNAS).

FY 2006 - This effort supports aviation ground advanced technology research.

	FY 2005	FY 2006
BRAIDED REDUCED RECOIL ROPE FOR HAND AND MOORING LINES	964	0

Initiated testing to prove that a braided 12-strand Reduced Recoil Rope will meet or exceed performance requirements as specified by the Navy. Testing will include sequential break failure, coefficient of friction

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

testing, torque and rotation testing and abrasion resistance testing.

	FY 2005	FY 2006
COMPOSITE TWISTED RUDDER	969	0

Completed development of a composite twisted rudder and started initial qualification tests. This rudder has a non-uniform cord shape optimized to minimize the angle of attack of the water flow, thereby minimizing cavitation. The composite rudder will not corrode, is lighter and easier to fabricate, and may have lower lifecycle cost.

	FY 2005	FY 2006
COPPER-CERAMIC SOLID OXIDE FUEL CELL TECHNOLOGY	0	1,000

This effort supports copper-ceramic solid oxide fuel cell technology research.

	FY 2005	FY 2006
DD(X) ADVANCED SHIP SERVICE FUEL CELL (SSFC) POWER PLANT	0	1,000

This effort supports DD(X) advanced Ship Service Fuel Cell(SSFC) power plant research.

	FY 2005	FY 2006
DEPLOYABLE FIBER OPTIC FORCE PROTECTION SYSTEM	1,737	0

Initiated optimized 3D underwater hydrophone tracking algorithms and demonstrate deployable fiber optic force protection system.

	FY 2005	FY 2006
DEVELOPMENT OF SULFER TOLERANT COPPER-BASED SOLID OXIDE FUEL CELL (SOFC)	967	0

Initiated research to investigate sulfur tolerant copper-based anode catalyst materials for solid oxide fuel

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

cells for future Navy applications. This includes test fixture fabrication, anode cell materials development, and associated testing.

	FY 2005	FY 2006
DOCKSHOCK	4,149	0

Initiated demonstration of a suitable shock generation device and system engineering for a full scale test capability.

	FY 2005	FY 2006
ELECTROMAGNETIC RAIL GUN TEST MUNITION	0	1,100

Initiated efforts including testing, validating performance, and establishing the range of possible shipboard applications of a quarter-scale actuator.

	FY 2005	FY 2006
ELECTROMAGNETIC PROPULSION COST REDUCTION	1,358	0

Initiated efforts to identify dual use technologies to reduce the cost of military and civilian applications of linear motor systems.

	FY 2005	FY 2006
ENABLING MATERIALS FOR MEMS FABRICATION AND PACKAGING	0	4,500

This effort supports enabling materials for MEMS fabrication and packaging research.

	FY 2005	FY 2006
EXTREME TERRAIN MEDICAL EVACUATION VEHICLE PILOT	1,640	0

Initiated the design, fabrication, and testing of a medical evacuation demonstrator vehicle capable of

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

achieving high speeds and improved ride quality over extreme terrain conditions. This vehicle incorporated advanced mobility technologies to improve crew safety and casualty evacuation performance. The vehicle is designed to be internally transportable in the new MV-22 tilt-rotor aircraft for increased expeditionary utility.

	FY 2005	FY 2006
FORCE PROTECTION DIGITAL DIRECTION FINDER	0	2,100

This effort supports for protection digital direction finder research.

	FY 2005	FY 2006
FOURTH GENERATION NAVAL PROPULSION PERMANENT MAGNET MOTOR	0	1,500

This effort supports fourth generation naval propulsion permanent magnet motor research.

	FY 2005	FY 2006
FUTURE NAVAL CAPABILITIES - CREW MODELING AND SIMULATION (FNC-CMS)	2,507	0

Initiated efforts to develop, validate and verify crew modeling and simulation that can be used as part of the Navy ship system design. This provides for a robust capability to determine the tactical and maintenance workload changes associated with new systems and significant systems changes.

	FY 2005	FY 2006
HIGH PERFORMANCE SANDWICH PANEL CONSTRUCTION TECHNIQUES	3,860	1,250

FY 2005 - Initiated the execution of three primary project tasks 1) develop a prototype manufacturing system, incorporating breakthrough process control and quality assurance (PC/QA) technology that is capable of cost-effectively producing steel sandwich panels; 2) Design a full manufacturing system capable of meeting the size, volume, quality and cost requirements of the US Navy; and 3) Manufacture demonstration panels of the size and shape needed in order to qualify the product for the targeted platforms including the CVN 21 class aircraft carriers.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

FY 2006 - This effort supports high performance sandwich panel construction techniques research.

	FY 2005	FY 2006
HIGH SPEED PERMANENT MAGNET GENERATOR	6,269	0

Continued design and construction of an approximately 3MW prototype high speed permanent magnet generator.

	FY 2005	FY 2006
HIGH TEMPERATURE SUPERCONDUCTING GENERATORS	0	3,500

This effort supports high temperature superconducting generators research.

	FY 2005	FY 2006
HIGH-SPEED POWER NODE SWITCHING CENTER	1,351	0

Initiated design and fabrication of a high-speed switching center based on state-of-the-art technology for shipboard applications.

	FY 2005	FY 2006
INTEGRATED ADVANCED COMMUNICATIONS TERMINAL	964	1,000

FY 2005 - Initiated efforts to develop the design and interface methodology to enable advanced integration of a variety of communications terminal architectures. This alleviates the necessity for duplicative common communication terminal components.

FY 2006 - This effort supports integrated advanced communications terminal research.

	FY 2005	FY 2006
LARGE UNMANNED UNDERSEA VEHICLE (LUUV) TEST BED	1,643	4,200

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

FY 2005 - Initiated design modifications to the existing Large Unmanned Undersea Vehicle (UUV) Test Bed that will facilitate advanced UUV systems and scaled advanced submarine propulsion systems demonstrations. This included development of a front end/controller interface architecture, modular section design concepts, vehicle handling equipment design, vehicle maneuvering and control design concepts, and land based testing of subsystems selected from the proposed design concepts.

Fy 2006 - This effort supports LUUV test bed resreach.

	FY 2005	FY 2006
LIFE CYCLE PROGRAM SUPPORT FOR UNMANNED SYSTEMS	0	3,400

This effort supports life cycle program support for unmanned systems research.

	FY 2005	FY 2006
LIGHT STRIKE MEDICAL EVACUATION VEHICLE PILOT	0	1,700

This effort supports light strike medical evacuation pilot research.

	FY 2005	FY 2006
M-65 BISMALEIMIDE CARBON FIBER PREPREG RESIN SYSTEM QUALIFICATION FOR USE WITH AUTOMATED PLACEMENT MACHINES	0	2,700

This effort supports the M-65 Biamaleimide Carbon Fiber prepreg resin system qualification for use with automated placement machines research.

	FY 2005	FY 2006
MISSILE WARNING SYSTEM	2,413	3,000

FY 2005 - Initiated development of a 2-color mid-wave infrared (MWIR) sensor technology for improved missile warning receiver (MWR) performance over current systems operating in the ultraviolet (UV). Specific efforts will address fabricating mercury-cadmium-telluride (MCT) focal plane arrays in a 2-color, stacked diode, 256-by-256 pixel architecture on 6-inch silicon wafer substrates for greatly improved affordability; and

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

developing a common sensor design to include visible and near-infrared (Vis/NIR) pulsed laser guidance detection along with 2-color MWIR missile plume detection in a single threat warning receiver, greatly reducing the cost and logistics burden of separate receivers.

FY 2006 - This effort supports missile warning system research.

	FY 2005	FY 2006
MOBILE MANUFACTURING AND REPAIR CELL	0	3,500

This effort supports mobile manufacturing and repair cell research.

	FY 2005	FY 2006
MULTI-FUEL PORTABLE FUEL CELL POWER PROJECT	0	1,000

This effort supports multi-fuel portable fule cell power project research.

	FY 2005	FY 2006
MULTI-MISSION WARHEAD FOR ULTRA-LIGHT TORPEDO	2,220	0

Initiated investigation, by analysis and full scale experiments to determine the effects on performance of combining defensive (omnidirectional) and offensive (directed energy) warhead technologies into a single multimode warhead for the 6.75" torpedo.

	FY 2005	FY 2006
MULTIPOLAR MOTOR	0	1,000

This effort supports multipolar motor research.

	FY 2005	FY 2006
NCDR - LIGHTWEIGHT, RUGGEDIZED RECONNAISSANCE ROBOT	0	1,300

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

This effort supports the NCDR-lightweight, ruggedized reconnaissance robot.

	FY 2005	FY 2006
NON-LINE OF SIGHT (NLOS) FOR UNMANNED SYSTEMS	4,149	0

Initiated modifications to hardware prototypes for the Omni-Directional Inspection System (ODIS), which provides an electronically transmitted view of the underside of a vehicle. Each ODIS is composed of a high-resolution camera mounted on a sophisticated, omni-directional mobile platform that transmits video back to an Operator. This system can potentially reduce the risk to Military Police in screening vehicular traffic into secure areas.

	FY 2005	FY 2006
PLANAR SOLID OXIDE FUEL CELL CLUSTER DEMONSTRATION	0	5,100

This effort supports planar solid oxide fuel cell cluster demonstration reasearch.

	FY 2005	FY 2006
POROUS SILICON-BASED DIRECT METHANOL FUEL CELL	0	1,750

This effort supports porous silicon-based direct methanol fuel cell research.

	FY 2005	FY 2006
PROJECT M	1,832	1,000

FY 2005 - Completed improvements to the Look-Ahead Detection Sensors (LADS) and an Engineering Development Model (EDM) of the shock mitigating seat. Fabricated, tested and delivered to SOCOM. (An EDM differs from an advanced development model (ADM) in that it is more robust and can be considered the prototype of a model that can be manufactured in large quantities.) The EDM operates as a semi-active system---not a totally active system.

FY 2006 - This effort supports Project M.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
PURE HYDROGEN SUPPLY FROM LOGISTICS FUEL	0	2,500

This effort supports pure hydrogen supply from logistics fuel research.

	FY 2005	FY 2006
REDUCED SHIP CREW BY VIRTUAL PRESENCE	0	1,000

This effort supports reduced ship crew by virtual presence research.

	FY 2005	FY 2006
REMOTE ENERGETIC MATERIAL MANUFACTURING FOR PYROTECHNIC INFRARED DECOYS	0	1,300

This effort supports research of remote energetic material manufacturing for pyrotechnic infared decoys.

	FY 2005	FY 2006
SHIP SERVICE FUEL CELL	0	3,000

This effort supports ship service fuel cell research.

	FY 2005	FY 2006
SMART SENSOR WEB ADVANCED TECHNOLOGY	1,737	0

Initiated efforts to develop and demonstrate an all digital interferometric signal detection and direction finder system.

	FY 2005	FY 2006
STRATEGIC MOBILITY 21 DEPLOYMENT TECHNOLOGY	4,149	2,600

FY 2005 - Funded a number of projects that dealt with the application of transportation technologies to

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

complementary Navy and civilian uses. Agile port efforts took the basic logistic cost estimates and arrangements derived from the FY 2004 effort and examined an alternative magnetic levitation technology to break the log jam between the port and an inland distribution center, or for military use between the depot and the port of embarkation. The fluid dynamic optimization synthesis design models were selectively applied to a number of dual use multi-hull vessel candidate designs. Completed the concept design development of a very high power axial water jet design, tested at model scale in FY 2004. Further technical development efforts on the large trimaran involved computational evaluations of the critical areas of hull form optimization, selected propulsion arrangements, and structural design issues involving regulatory approval.

FY 2006 - This effort supports strategic mobility 21 deployment technology research.

	FY 2005	FY 2006
SUPERCONDUCTING DC HOMOPOLAR MOTOR FOR ELECTRIC DRIVE SHIPS	3,574	1,200

FY 2005 - Continued brush technologies that will allow the full scale motor to meet fleet application requirements. Continued design of the 36.5MW motor and power system.

FY 2006 - This effort supports the superconducting DC homopolar motor for electric drive ships research.

	FY 2005	FY 2006
TADIRCM ANTIMISSILE TECHNOLOGY	6,559	0

Initiated development of advanced component technologies for the Tactical Aircraft Directed Infrared Countermeasures (TADIRCM) Early Operational Analysis (EOA) pod effort. These include: (a) high power, multi-band mid-wave infrared (MWIR) lasers with improved beam quality, beam stability, efficiency and output power that can operate at the elevated temperatures and high-G/high vibration environment of a tactical jet pod installation; (b) MWIR transmitting fiber optics to improve coupling of the multi-band laser to the jam head beam director; (c) low profile, light weight, shared-axis fine trackers and beam directors with reduced pointing jitter and advanced auto-bore-sight capability that are suitable for high-G/high vibration operation; and (d) advanced missile warning receivers with low-cost fully athermalized and achromatic optics and advanced processing algorithms for rapidly geo-locating surface-to-air missile launch sites.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
TECHNOLOGIES FOR FUTURE NAVAL CAPABILITIES	1,254	0

Continued to develop realistic features to the test-bed model of the unmanned surface vehicle to be employed in the development of control and monitoring algorithm. Continued establishing techniques to evaluate the performance and the viability of the models, simulations and signal processing.

	FY 2005	FY 2006
UNIVERSAL SOLID STATE BREAKER	0	1,000

This effort supports universal solid state breaker research.

	FY 2005	FY 2006
UNMANNED FORCE AUGMENTATION SYSTEM	974	3,000

FY 2005 - Initiated efforts to conduct research, development and testing of advanced unmanned aerial vehicle (UAV) technologies, including the design and integration of an avionics suite and flight demonstration of the system. If successful, this effort will provide the Navy with a much-improved shipboard landing capability for fixed wing unmanned aircraft.

FY 2006 - This effort supports unmanned force augmentation system research.

	FY 2005	FY 2006
UNMANNED SYSTEMS TECHNOLOGIES FOR EXPLOSIVE ORDNANCE DISPOSAL	4,158	1,300

FY 2005 - Initiated development of S&T tools and capabilities necessary for the military and law enforcement Explosive Ordnance Disposal (EOD) technicians to meet the various EOD, Improvised Explosive Device (IED), and Unexploded Ordnance (UXO) challenges and reduce the risk to the personnel by developing unmanned systems to perform these dangerous and critical missions.

FY 2006 - This effort supports unnmanned systems technologies for explosive ordnance disposal research.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
VARICRAFT	6,079	0

Produced a contract design for the vessel, procured items relating to the propulsion plant, produced the integrated propulsion plant and the completed detail construction design.

	FY 2005	FY 2006
WAVE POWER DEMONSTRATION PROJECT	3,286	0

Explored more efficient methods of converting wave energy to electrical energy and developed an improved mooring system.

	FY 2005	FY 2006
WAVE POWERED ELECTRIC POWER GENERATING SYSTEM FOR NAVAL BASE	0	1,500

This effort supports wave powered electric power generating system for naval base research.

	FY 2005	FY 2006
WIDE BANDGAP SEMICONDUCTOR SUBSTRATE MATERIALS	4,341	5,600

FY 2005 - Initiated development of semiconductor materials capable of higher power levels and greater temperature ranges than currently employed silicon-based materials.

FY 2006 - This effort supports wide bandgap semiconductor substrate materials research.

	FY 2005	FY 2006
WIRELESS CONDITION-BASED MAINTENANCE MONITORING FOR SHIPYARD EQUIPMENT AND FACILITIES	0	3,200

This effort supports wireless condition-based maintenance monitoring for shipyard equipment and facilities research.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
WIRELESS SENSOR SYSTEM	0	1,400

This effort supports wireless sensor system research.

	FY 2005	FY 2006
X – CRAFT	10,282	10,500

FY 2005 - Completed construction of LSC(X) (aka “X-Craft”) and delivered to fleet in June 2005. Installed active rudder system to provide steering redundancy and increase directional stability. Installed various “fleet ready” upgrades to allow use of vessel in fleet exercises in support of LCS risk reduction. Upgrades included damage control systems, C4I and shock-mitigating seats. Operated vessel in support of LCS risk reduction.

FY 2006 - This effort supports X-craft research.

	FY 2005	FY 2006
ZEUS LIGHT STRIKE VEHICLE HYBRID ELECTRIC PILOT	0	1,000

This effort supports reasearch of the Zeus light strike vehicle hybrid electric pilot.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N
PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	83,365	73,056	61,725	42,739	42,971	47,424	52,282
2919 COMMUNICATIONS SECURITY	78,153	59,656	61,725	42,739	42,971	47,424	52,282
9999 CONGRESSIONAL PLUS-UPS	5,212	13,400	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) addresses the advanced technology development, test and evaluation of a dynamic distributed common picture based on emergent technologies that will improve situational awareness across command echelons. The promise of net-centricity and potential for persistent and pervasive sensing create greater demand for automated fusion of large volumes of multi-sensor data, techniques to coordinate deployment of multiple diverse sensors and tailored dissemination of information to support. The focus for this PE is to refine technologies that exploit information and networking technology to ensure mission success in unpredictable warfighting environments, such as the Global War on Terrorism, urban operations, and asymmetric warfare. To ensure Maritime Domain Awareness, we must be able to collect, fuse, and disseminate enormous quantities of data drawn from US joint forces and government agencies, international coalition partners and forces, and commercial entities. To further network centric capability, this project demonstrates technologies that support seamless information services afloat and ashore; collaborative decision-making among geographically dispersed warfighters; a common, consistent view of the battlespace geared to user requirements; system interoperability with coalition forces; real-time information access with quality of service guarantees; and information assurance. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to rapid, accurate decision-making that lead to decisive, precise, and desired engagement outcomes. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower. The Common Picture Program supports FORCEnet, Sea Shield and Sea Strike pillars. This program element contains investments in the following FORCEnet, Sea Strike and Sea Shield enabling capabilities: Secure Collaboration; Advanced Communication for

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N
PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY

FORCEnet; GIG Compliant Networking; Dynamic Target Engagement and Enhanced Sensor Capability; Next Generation Command, Control and Decision Support Services; COCOM to Marine Combat ID; Combat ID Information Management of Coordinated Electronic Surveillance; Combat ID in the Maritime Domain to Reveal Contact Intent; Hostile Automated Control of Large Sensor Networks; and Hostile Fire Detection and Response Spiral 1.

In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet, “Persistent Intelligence, Surveillance, and Reconnaissance,” “Time Sensitive Strike,” “Sea Based Information Operations,” “Sea Strike” Ship-to-Objective Maneuver, and “Sea Shield” Theater Air and Missile Defense.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N
PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	83,062	60,589	53,471
Congressional Action	1,000	13,400	0
Congressional Undistributed Reductions/Rescissions	-64	-933	0
Execution Adjustments	981	0	0
FY 2005 SBIR	-1,615	0	0
Program Adjustments	1	0	0
Program Realignment	0	0	8,196
Rate Adjustments	0	0	58
FY 2007 President's Budget Submission	83,365	73,056	61,725

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
Performance metrics are discussed within the project (R2a).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2919 COMMUNICATIONS SECURITY	78,153	59,656	61,725	42,739	42,971	47,424	52,282

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) addresses the advanced technology development, test and evaluation of a dynamic distributed common picture based on emergent technologies that will improve situational awareness across command echelons. The promise of net-centricity and potential for persistent and pervasive sensing create greater demand for automated fusion of large volumes of multi-sensor data, techniques to coordinate deployment of multiple diverse sensors and tailored dissemination of information to support. The focus for this PE is to refine technologies that exploit information and networking technology to ensure mission success in unpredictable warfighting environments, such as the Global War on Terrorism, urban operations, and asymmetric warfare. To ensure Maritime Domain Awareness, we must be able to collect, fuse, and disseminate enormous quantities of data drawn from US joint forces and government agencies, international coalition partners and forces, and commercial entities. To further network centric capability, this project demonstrates technologies that support seamless information services afloat and ashore; collaborative decision-making among geographically dispersed warfighters; a common, consistent view of the battlespace geared to user requirements; system interoperability with coalition forces; real-time information access with quality of service guarantees; and information assurance. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to rapid, accurate decision-making that lead to decisive, precise, and desired engagement outcomes. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower. The Common Picture Program supports FORCEnet, Sea Shield and Sea Strike pillars. This program element contains investments in the following FORCEnet, Sea Strike and Sea Shield enabling capabilities: Secure Collaboration; Advanced Communication for FORCEnet; GIG Compliant Networking; Dynamic Target Engagement and Enhanced Sensor Capability; Next Generation Command, Control and Decision Support Services; COCOM to Marine Combat ID; Combat ID Information Management of Coordinated Electronic Surveillance; Combat ID in the Maritime Domain to Reveal Contact Intent; Hostile Automated Control of Large Sensor Networks; and Hostile Fire Detection and Response Spiral 1.

In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

required by FORCEnet, “Persistent Intelligence, Surveillance, and Reconnaissance,” “Time Sensitive Strike,” “Sea Based Information Operations,” “Sea Strike” Ship-to-Objective Maneuver, and “Sea Shield” Theater Air and Missile Defense.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
KNOWLEDGE SUPERIORITY AND ASSURANCE (KSA)	44,662	31,944	41,695

This activity is aligned with the FORCEnet pillar and explores fundamental technologies that enhance the Navy’s capability to exploit, manage and integrate complex, heterogeneous, multi-source information for the next generation common picture. Science and Technology (S&T) work is being focused on Navy and Marine Corps Warfighter Capability Gaps identified through analysis of operational and exercise lessons learned, as well as campaign analysis of capabilities required in the 2010-2015 time frame.

There are several FNC efforts that completed in FY 2005 and three efforts transitioning to other PEs in FY 2006. The funding profile from FY 2006 to FY 2007 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. Warfighter Capability Gaps are being addressed by Enabling Capabilities (EC). Each EC delivers capability-level products to acquisition in a three to five-year effort, and allocates a sufficient investment to ensure a capability is provided. ECs addressed include: Secure Collaboration; Advanced Communication for FORCEnet; GIG Compliant Networking; Dynamic Target Engagement and Enhanced Sensor Capability; Next Generation Command, Control and Decision Support Services; COCOM to Marine Combat ID; Combat ID Information Management of Coordinated Electronic Surveillance; Combat ID in the Maritime Domain to Reveal Contact Intent; and Automated Control of Large Sensor Networks.

FY 2005 Accomplishments:
• Completed work on Wireless Quality of Service (QoS) Based Routing for FORCEnet and transitioned to Automated Digital Network System (ADNS) (PMW 160).
• Completed work on K/Ka/Q-band phased array antennas for submarine, ship, and mobile ground vehicles.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

Transitioned to Program Executive Office (PEO) C4I & Space Program Management of Warfare (PMW) 770/Advanced High Data Rate Antenna.
• Completed Battle Force Composite Networking Block II. Transitioned to Joint Task Force (JTF WARNET) and Joint Tactical Radio System Joint Program Office (JTRS JPO). Alternated high data rate path for disadvantaged platforms for improved SIPRNET throughout, reliability, and redundancy with automated and network routing.
• Completed Sea Trial Experimentation on capability to access, update, and maintain the Common Operational and Tactical Picture (COTP) through an integrated and interoperable set of software applications.
• Completed Sea Trial Experimentation on the Multi-National Virtual Operations Capability (MNVOC) Battle Force Email High Frequency (HF) Local Area Network system to carry Internet Protocol (IP) data over HF (and other Line of Sight Systems) to complement satellite communications assets.
• Continued development of the Airborne Communication Package for the FIRESCOUT Unmanned Aerial Vehicle (UAV).
• Continued effort for Comprehensive, Analytic, Real-Time Execution in Joint Air Operations (CARTE).
• Continued development of Multi-National Virtual Operations Network, including Domino One-way Replication Services (DORS) and Unit Level Multi-level Thin Client Prototype, with transition to PMW-160. Significantly enhances network centric interoperability among allies and coalition partners by providing at-sea reliable, secure, and timely exchange of releasable tactical information through use of virtual private networks and secure web servers Concepts (PMA-263).

• Initiated effort for Reconfigurable Surveillance UAVs for Warfighter Protection. (Moves to PE 0603114N in FY 2006).
• Initiated Joint Coordinated Real-Time Engagement (JCRE) Advance Concepts Technology Demonstration (ACTD) to provide Global Information Grid (GIG)-compliant core enterprise Services and Community of Interest (COI) Services which ensured warfighting COIs access to information required from any source for rapid situation awareness assessment.
• Initiated effort for Decision Support for Dynamic Target Engagement.
• Initiated Information Assurance effort called Secure Distributed Collaboration.
• Initiated effort on Integrated Autonomous Network Management (IANM).
• Initiated an Ultra-High Frequency (UHF)/L-Band Phased Array Antenna for Naval aircraft carrier platforms. (Moves to PE 0603271N in FY 2006).

FY 2006 Plans:
• Continue all efforts of FY 2005, less those noted as completed above.
• Continue effort on Processing Tactical Signal Intelligence (SIGINT) (Sly Fox) (follow on to Tactical Processing and Analysis initiated in PE 0602235N). Automate back-end software that supports the Shipboard

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

Information Warfare and Cryptologic System Acquisition Front-end, resulting in 75% reduction of operator effort associated with processing intercept reports, and a 50% decrease in operator errors and a 50% reduction in training hours.
• Complete Airborne Communications Package (ACP). Transition to FIRESCOUT program, Program Management Warfare (PMW) 760. Extends penetrating surveillance range to an area greater than 80 nautical miles. Transition to Program Executive Office (PEO) C4I, PMW-160 and NAVAIR 4.0x, Advanced Development Program for Airship.
• Complete effort for Comprehensive, Analytic, Real-Time Execution in Joint Air Operations (CARTE). Transition to Program Management (PM) Computer Aided Cost Estimate (CACE) MCSC/JSF. Automated Squadron-level coordinated Operations & Maintenance scheduling tools for AV8-Bs (reduce scheduling time from six hours to two minutes).
• Complete transition of Intra Battlegroup Wireless Networking to ADNS (PMW 160).
• Complete transition of Multi-National Virtual Operation Network, including Domino One-way Replication Services (DORS) and Unit Level Multi-level Thin Client Prototype, with transition to PMW-160. Significantly enhances network centric interoperability among allies and coalition partners by providing at-sea reliable, secure, and timely exchange of releasable tactical information through use of virtual private networks and secure web servers Concepts (PMA-263).
• Initiate and complete Sea Trial Experimentation of command decision-making and dynamically managed connectivity (e.g., Decision Support for Dynamic Target Engagement; Secure Distributed Collaboration; Processing Tactical SIGINT, Integrated Autonomous Network Management (IANM); as well as replanning and rehearsals of operational and tactical forces).
• Initiate Actionable Information from Multiple Intel Sources in a Global Information Grid Enterprise Services (GIG-ES) Environment. Automate integration of multi-INT surveillance & reconnaissance of red, white, and blue force locations for Combat ID by providing software integrated into Navy and Marine Corps Command Control & Combat Systems. Order of magnitude less false recognition. Identification of significant military entities consistent with sensor capabilities. Work continues under PE 0602235N in FY 2007.
• Initiate effort for Improved Maritime Common Operational Tactical Picture in a GIG-ES Environment. Provides software to perform level one fusion of intelligence sources and tactical organic sensors to provide knowledge about battlespace objects including location, track, and Combat Identification. Improve planning and resource management of ISR assets allocated to fill ISR coverage gaps, with 100X improvement over current performance. More effective allocation of assets to eliminate redundant coverage, with 100% more coverage or 50% reduction in planned sensor asset usage. (Moves to PE 0602235N in FY 2007)
• Initiate design of tools enabling mission-specific tactical sensor fields for at least two separate mission areas. (Moves to PE 0602235N in FY 2007)
• Initiate design of tactical distributed data analysis and automated indications and warnings for 50% of

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

tactical data. (Moves to PE 0602235N in FY 2007)
• Initiate design of automated tactical platform and sensor planning and management sufficient for one operator to control of multiple sensors. (Moves to PE 0602235N in FY 2007)

FY 2007 Plans:
• Continue all efforts of FY 2006, less those noted as completed above.
• Complete effort on Processing Tactical Signal Intelligence (SIGINT) (Sly Fox).
• Complete development of Integrated Autonomous Network Management. Transition to (Item Serial Numbers/Automated Digital Network System) ISNS/ADNS PMW-160. Enables central monitoring of as many as 15 distributed network management systems, tactical shore and ship, in a 1500 nm area. Network automatically assesses the environment and recommends changes to optimize network performance in real time (10s of seconds). There will be manpower savings, fewer personnel required to manage computers, and communication networks for big-deck ships.
• Complete development of Secure, Distributed Collaboration effort. Transition to the PEO for C4I and Space, for the PMW 160 program. Combined Enterprise Regional Information Exchange System (CENTRIXS) for secure collaboration across multiple coalition boundaries and security levels in the maritime environment. Enhances real-time collaboration among coalition partners and own forces. Increase speed of decisions based on integrated and shared tactical picture. Enforces security policy providing increase in assurance level. Reduces administrative overhead by automating functions.
• Complete the High Altitude Airborne Relay and Router Package to deliver multi-beam relay/router in high altitude capability across UHF/VHF/L- and Ku-Bands (previously reported in PE 0603271N).
• Complete the Innovative Tactical Beyond Line of Sight (BLOS) Communications Relay (previously reported in PE 0603236N).
• Complete Ultra High Frequency (UHF)/L-Band phased array antennas for carriers (previously PE 0603271N).
• Initiate design of tools enabling mission-specific tactical sensor fields for at least two separate mission areas.
• Initiate smart algorithms for tactical sensors.

	FY 2005	FY 2006	FY 2007
USCG VESSEL TRACKING	9,996	4,459	4,830

Details are of a higher classification.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

	FY 2005	FY 2006	FY 2007
MULTI-SOURCE INTEGRATION (MSI) AND COMBAT IDENTIFICATION (CID)	8,587	8,796	7,410

This activity is aligned with the Sea Shield pillar. Multi-Source Integration (MSI), Advanced Sensor Netting Technology (ASNT), and Composite Combat Identification (CCID) technology address theater air and missile defense (TAMD) needs for data fusion, correlation of and reasoning over attributes leading to target Identification, and sensor fusion/management. The goal is to develop algorithms for use by air defense combat systems which will then be able to fuse, filter, and correlate on-board sensor and off-board battlespace information from all sources to achieve one common Combat Identification (CID) solution using Theater-wide information. This activity supports the Sea Shield Enabling Capability for Real Time Long Range Air Defense CID in Support of Early Engagements and related CID Science & Technology to be worked under FORCEnet.

FY 2005 Accomplishments:
• Continued development of advanced MSI algorithms to integrate radio frequency sensors, Identification Friend or Foe (IFF) data, Cooperative Engagement Capability (CEC), Joint Tactical Information Distribution System (JTIDS), and correlate Satellite Communications (SATCOM) data to integrated track files in the E-2C/D airborne early warning aircraft mission computer.
• Continued development of CCID algorithms designed to correlate and fuse real time track data with intelligence, surveillance and reconnaissance data in Ship Signal Exploitation Equipment (SSEE) equipped surface ships. Continued evolutionary development of a common reasoning algorithm for CID capability to rapidly build high confidence identification of air tracks using all available Identification attributes in theater.
• Completed development and demonstration of ASNT multiple hypothesis correlation algorithms in a laboratory environment. These algorithms were designed for integration of electronic warfare support data into CEC and transmission of track Identification attributes via CEC-like network.
• Completed coordination of MSI, ASNT, and CCID development with the Joint Single Integrated Air Picture (SIAP) Systems Engineering Organization (JSSEO) Integrated Architecture Behavior Model (IABM) for use in joint service open architecture combat system applications.

FY 2006 Plans:
• Continue all efforts of FY 2005, less those noted as completed above.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

FY 2007 Plans:
• Continue all efforts of FY 2006.
• Complete ASNT, CCID, and MSI development. MSI, ASNT, and CCID will transition to the E-2C/D Program Management Office (PMA-231), Intelligence, Surveillance, Reconnaissance, and Information Operations Program Office (PMW-180), and Program Executive Office-Integrated Warfare Systems (PEO-IWS).
System.

	FY 2005	FY 2006	FY 2007
PLATFORM PROTECTION/ELECTRONIC WARFARE SYSTEMS	7,189	7,215	0

This activity is aligned with the Sea Strike pillar and supports the development of Situational Awareness (SA) capabilities for small surface, ground-based and airborne platforms. Currently, these platforms have limited SA capability, which jeopardizes their battlefield effectiveness and combat survivability. This activity develops the Electronic Warfare Integrated System for Small Platforms (EWISSP), a compact small platform electronic warfare capability providing radio frequency (RF), electro-optic (EO), and infrared (IR) sensors for platforms such as smaller ships, expeditionary fighting vehicles (EFV), and surveillance aircraft. This activity integrates successful proof-of-concept hardware and software developed under PE 0602235N into systems suitable for capability demonstration under Naval environments and tactical conditions. Responding to customer reprioritization of requirements based upon threat capabilities, the initial focus of the EWISSP program will be toward the development of an EO/IR detection, warning, and countermeasures capability with future capabilities development in the RF technology area. This activity includes support to the Sea Strike Enabling Capability for Hostile Fire Detection and Response Spiral 1 (U/A OPS EC 1C).

The decrease in funding from FY 2006 to FY 2007 is due to the EWISSP program moving to PE 0603114N in FY 2007.

FY 2005 Accomplishments:
• Continued the development of advanced technology applications to increase the survivability of the Marine EFV.
• Continued development of the EO countermeasures subsystem.
• Continued testing prototype flexible masts for EO countermeasures sensors in parallel with compatibility testing with existing and/or planned basic physical and electrical designs and features of the EFV platform.
• Continued integration of the EWISSP with the EFV to address issues related to limited space and power available in the EFV as well as severe restrictions on modifications to the vehicle's exterior configuration.
• Initiated assembly and integration of the Situational Awareness (SA) (2.0-18.0 GHz) and Electronic Attack

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

(EA) subsystems. Focus was on hardware and software integration at the subsystem level.
• Initiated incremental testing of the four categories of subsystems as they were assembled to ensure technical performance requirements are being met.
• Initiated implementation of design configuration management as part of the transition effort to track development and integration progress and identify technology insertion points with a maximum overall limitation of 10 percent of platform cost.

FY 2006 Plans:
• Continue all efforts of FY 2005.
• Complete fabrication and test of EWISSP subsystems. Integrate subsystems into EWISSP prototype systems for final demonstration and test.
• Initiate EWISSP IR Threat Warning System (IR TWS) Operational Demonstration. Show capability of the IR TWS to detect simulated missiles in a field environment, including evaluation of response time, azimuth and elevation accuracy, and false alarm rate as compared to the performance goals of 90 deg azimuth x 45 deg elevation with .5 deg resolution.
• Initiate field demo of integrated system on surrogate vehicle (High Mobility Multi-purpose Wheeled Vehicle (HMMWV)), to demonstrate EO/IR sensor detection and cueing of laser decoy, the 310 pound Multi-function Electro Optical System (MEOS) countermeasures, and optical augmentation for situational awareness and target detection and Identification.

FY 2007 Plans:
• The EWISSP program moves to PE 0603114N.

	FY 2005	FY 2006	FY 2007
GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY	4,803	4,459	4,850

This activity enhances Global Positioning System anti-jam (GPS AJ) capabilities and develops other technologies to provide alternative navigation methods. In the GPS AJ area, Space-Time Adaptive Processing (STAP) is being pursued to remove the operational risks associated with enemy jamming of GPS functions. Also, the next generation GPS receiver will be programmed with M-code; therefore, both the next generation M-code and the existing C/Y-codes must be used at the same time frame. Office of Naval Research initiated a transitional receiver which will accommodate both the C/Y- and M-codes. The alternative navigation methods investigated include GPS receivers with a tightly coupled Inertial Navigation System (INS); organic Link-16 relative navigation; gravity gradiometer development, used in a terrain-following concept; and an electro-

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

optic accelerometer developed as an improved element in INS. This activity also develops the atomic clock for inclusion in Naval Systems. The atomic clock efforts include small, low-cost Rubidium (Rb), and Coherent Population Trapping (CPT) atomic clock development. These areas will provide alternatives to GPS navigation and alternatives to the availability of precise GPS-provided time transfer.

FY 2005 Accomplishments:
• Continued the development and simulation of GPS M-code and C/Y-code input to refine specifications for multi-code Applications Specific Integrated Circuit (ASIC) development.
• Continued the development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) accelerometer for navigation systems; fabricated an Electro-optic Accelerometer.
• Continued the development of algorithms for distributed time scaling other supporting scaling; developed architectures necessary to establish a Navy Global Coordinated Time Scale; tested the algorithms via both simulation and using actual clock data provided by the U.S. Naval Observatory (USNO).
• Continued the development of a 10cc Rubidium (Rb) Coherent Population Trapping (CPT) atomic clock for tactical applications.
• Completed the integration of the Frequency Hopping (FH) M-code correlator, data recorder, and Field Programmable Gate Array (FPGA) GPS software receiver card. Also, conducted fast M-code acquisition tests.
• Completed the development of the Adaptive Bathymetric Estimator (ABE).
• Initiated the development of an Optical Ring Gyroscope Chip. Fabricated dual-arm, 2 cm diameter optical ring resonator in neodymium-doped substrates, and incorporated an electro-optics phase modulator into the ring.
• Initiated the demonstration project of nonlinearity-constrained adaptive beam forming for defeating BPSK jammers. Developed an algorithm to mitigate the loss of Signal-to-Noise Ratio (SNR) through a combination of adaptive space-time-frequency signal processing techniques.

FY 2006 Plans:
• Continue all efforts of FY 2005, less those noted as completed above.
• Complete the development of a 10cc Rb Coherent Population Trapping (CPT) atomic clock for tactical applications.
• Complete the fabrication of an ASIC chip for GPS M- and C/Y-code and test with GPS II and GPS III signals.
• Initiate the development of two gravity gradient devices. The first is an Octadecahedral Gravity Gradiometer in which the full-Gravity Gradient sensor is determined to separate translational and rotational effects from gravity effects. The second is a Ribbon Sensor Gravity Gradiometer whose vibrational modes in a gravitational field can be related to the gravity gradient tensor elements.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

• Initiate the development of magnetic map requirements for Magnetic Passive Navigation (MPN). Define top-level MPN performance requirements, establish MPN reset algorithm, develop system hardware requirements, investigate existing magnetic maps and models, develop map and modeling requirements, determine risk areas, evaluate performance projections, and prepare a final report.

FY 2007 Plans:
• Continue all efforts of FY 2006, less those noted as completed above.
• Initiate the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications. Initiate the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications.
• Initiate the Integrated Optically Transduced Gyro Assembly (IOTA) project.
• Initiate the Enhanced AJ GPS Receiver Technology (EAGRT) project.
• Initiate the Advanced Anti-Spoofing Detection and Isolation for GPS Acquisition project.
• Initiate the Scaleable Integrated Micro Optical Gyroscope (SIMOG) project.
• Initiate the Navigation Grade Microfabricated Integrated Optical Gyro (MIOG) project.
• Initiate the Navigation Grade Sub-Harmonic Lateral Mode Gyro (GSLMG) project.

	FY 2005	FY 2006	FY 2007
INFORMATION SECURITY RESEARCH	1,916	1,783	1,940

The goal of this activity is to protect the Navy and Joint information infrastructure from hostile exploitation and attack. This requires situational awareness of network assets and operations. This activity focuses, in part, on integrating successful proof-of-concept research prototypes developed under PE 0602235N. The goal is to develop tools, techniques and methodologies in order to: improve network resistance to denial of service attacks; improve indications and warnings of suspect activities; conduct traffic analysis; monitor and assess network status and health; identify new capabilities to analyze and network vulnerabilities and attacks; measure the effectiveness of Information Assurance (IA) protective measures; and improve the quality and level of certification of IA software.

FY 2005 Accomplishments:
• Continued the development and demonstration of correlated statistical analysis of pro-active monitoring of intrusive network behaviors, specifically addressing network misuse at the lowest/slowest event level (e.g., low bandwidth, high timeline events).
• Completed development, demonstration, and common criteria evaluation of the Naval Research Laboratory (NRL)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

Network Pump for its ability to transfer data securely from high to lower levels of classification across dissimilar networks while providing strong authentication and secure administration capabilities.
• Initiated development of a secure, survivable, and dynamic service-oriented enterprise architecture to support military missions, addressing grid computing, peer-to-peer computing, and the adaptation of security and survivability features to those technologies for military use.

FY 2006 Plans:
• Continue all efforts of FY 2005, less those noted as completed above.
• Complete the development and demonstrate correlated statistical analysis of pro-active monitoring of intrusive network behaviors, specifically addressing network misuse at the lowest/slowest event level (e.g., low bandwidth, high timeline events).
• Initiate development of the security management tool that provides a common picture of the networked environment with respect to information assurance and security, with emphasis on visualization capabilities to support active computer network defense.
• Initiate development of a tool for the development of agents that integrates unified modeling language (UML) and that provides a verifiable agent programming language, an inter-agent communication protocol, security agents for enforcing run-time properties, and property checkers.

FY 2007 Plans:
• Continue all efforts of FY 2006, less those noted as completed above.
• Complete the development of and demonstrate a secure, survivable, and dynamic service-oriented enterprise architecture to support military missions, addressing grid computing, peer-to-peer computing, and the adaptation of security and survivability features to those technologies for military use.
• Initiate development of integrated capabilities that support battle damage assessment and infrastructure and asset protection based on information provided by the common picture of the networked environment with respect to information assurance and security.

	FY 2005	FY 2006	FY 2007
MARINE MAMMALS	1,000	1,000	1,000

This initiative provides data and technology for making informed decisions regarding the interaction of naval activities with protected marine life and habitats to enable platform operation and force projection, and maximize use of Navy training ranges within environmental constraints. Ensure Navy compliance with national

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

environmental laws, Executive Order 12114, and SECNAVINST 5090.1.b while still maintaining full operational and training exercise capabilities.

FY 2005 Accomplishments:
• Continued temporary threshold shift (TTS) data collection to determine time, energy trade-off and recovery rates for long duration sound exposures and multiple pings typical of Navy operations and training.
• Expanded Marine Mammal Monitoring (M3R) frequency bandwidth for tracking beaked whales. Develop classification software for identification of marine mammal species and populations. Continued Atlantic Undersea Test Evaluation Center (AUTEC) on-site analysis and Pacific Missile Range Facility (PMRF) data collection with visual surveys. Initiated Technology Readiness Level (TRL) assessment and transition plan.

FY 2006 Plans:
• Continue all efforts of FY 2005.
• Develop an Acoustic Safety Criteria Model for multiple sonar pings on dolphins and toothed whales.
• Complete TTS data collection for dolphins.
• Complete M3R TRL and transition plan; develop technology transition agreement (TTA) with CNO N45. Test M3R classification software for identification of species/populations and complete M3R Technology development at AUTEC.
• Initiate TTS data collection to develop cumulative sound exposure model for seals and sea lions.

FY 2007 Plans:
• Continue all efforts of FY 2006 less those noted as completed above.
• Complete TTS Acoustic Safety Criteria Model for multiple sonar pings on toothed whales.
• Initiate transition plan for demonstration and evaluation of M3R technology at other Navy ranges.
• Initiate sound exposure study at AUTEC to develop effective M3R mitigation methodology for Navy ranges.
• Initiate transition from behavioral to electrophysiological measurements of hearing/TTS in marine mammals.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:

PE 0601153N (Defense Research Sciences)
PE 0602114N (Power Projection Applied Research)
PE 0602123N (Force Protection Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2919 PROJECT TITLE: COMMUNICATIONS SECURITY

PE 0602235N (Common Picture Applied Research)
PE 0602236N (Warfighter Sustainment Applied Research)
PE 0602271N (RF Systems Applied Research)
PE 0603114N (Power Projection Advanced Technology)
PE 0603123N (Force Protection Advanced Technology)
PE 0603236N (Warfighter Sustainment Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603609N (Conventional Munitions)
PE 0603640M (USMC Advanced Technology Demonstrations)
PE 0603658N (Cooperative Engagement)
PE 0603727N (Joint Experimentation)
PE 0604307N (Surface Combatant Combat System Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0206313M (Marine Corps Communications Systems)
PE 0303140N (Information Systems Security Program)
PE 0308601N (Modeling and Simulation and Support)

NON-NAVY RELATED RDT&E:

PE 0603750D8Z (Advanced Concept Technology Demonstrations)

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
AUTONOMOUS SERVICE AGGREGATION FOR THE EXPEDITIONARY WARFARE TESTBED	0	1,000

This effort supports research into the autonomous service aggregation for the expeditionary warfare testbed.

	FY 2005	FY 2006
CIP ADVISOR FOR GLOBAL MARITIME AWARENESS	0	1,000

This effort supports Critical Infrastructure Protection (CIP) advisor for global maritime awareness research.

	FY 2005	FY 2006
CONSOLIDATED UNDERSEA SITUATIONAL AWARENESS SYSTEM (CUSAS)	3,278	2,900

FY 2005 - This effort continued development of the openly-architected agent-based decision support software for the Undersea Warfare Decision Support System and the Aircraft Carrier Tactical Support Center. The deliverable was an agent-based software module for the Anti-Submarine Warfare Combat, Command, and Control System.

FY 2006 - This effort supports CUSAS research.

	FY 2005	FY 2006
DYNAMIC BROKERING IN THE EXPEDITIONARY WARFARE TESTBED	964	0

This effort developed dynamic brokering capabilities in the expeditionary warfare tested for refining the discovery process of the service-based architecture to support faster performance, better communications throughout usage, and the underpinnings of multi-level security to support user requirements. The open service-based Expeditionary Warfare Testbed architecture supported the inclusion of new web services. Scalability and usability dictated minimizing redundancy while maintaining quality of service.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
IMPROVED SHIPBOARD COMBAT INFORMATION	0	2,000

This effort supports improved shipboard combat information research.

	FY 2005	FY 2006
INTERNET PROTOCOL VERSION 6	970	1,000

FY 2005: This effort developed the Internet Protocol Version 6 (IPv6) testbed consisting of servers, clients and infrastructure, including external site partners. The project developed remote facilities required to model, simulate and test IPv6 in stressed mobile RF environments. Draft IPv6 protocols addressing Mobile Ad-Hoc Network (MANET), Load Balancing and Auto-Configuration of network participations were tested and evaluated. Current status shows that implementation of these concepts with IPv6 protocols will yield improved circuit connectivity, versatility and robustness over current practices.

FY 2006 - This effort supports internet protocol version 6 research.

	FY 2005	FY 2006
MARITIME DOMAIN IDENTIFICATION SYSTEM	0	1,000

This effort supports maritime domain identification system research.

	FY 2005	FY 2006
MIST AFFORDABLE HIGH RESOLUTION PHASED ARRAY RADAR	0	3,000

This effort supports MIST affordable high resolution phased array radar research.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
SHIPBOARD AUTOMATED RECONSTRUCTION CAPABILITY	0	1,500

This effort supports shipboard automated reconstruction capability research.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	90,154	106,927	82,035	113,390	105,453	108,793	116,140
2915 WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	55,222	61,459	82,035	113,390	105,453	108,793	116,140
3008 HIGH SPEED SEALIFT VESSEL	2,589	668	0	0	0	0	0
9999 CONGRESSIONAL PLUS-UPS	32,343	44,800	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Warfighter Sustainment Advanced Technology supports: Manpower and Personnel, Training, and Readiness; and the Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff. It supports the Future Naval Capabilities (FNC) Program in Airframe/Ship Corrosion; Turbine Engine Technologies; Littoral Combat; Sea Base Planning, Operations and Logistics; and Sea Base Mobility and Interfaces. It develops technologies that enable the Navy to better recruit, select, classify, assign, and manage its people; to train effectively and affordably in classroom settings, in simulated and actual environments, and while deployed; and to effect human systems integration into weapon systems. Other technologies enable reduced operating costs through life-extension of legacy systems and increased efficiency of future propulsion systems and improved diagnostic tools.

Within the Naval Transformation Roadmap, this investment supports the achievement of all the transformational capabilities of Sea Warrior and the transformational capabilities of: Ship to Objective Maneuver and Time Sensitive Strike required by Sea Strike; Littoral Sea Control and Anti-Sub Warfare required by Sea Shield; Compressed Deployment and Employment Times and Enhanced Sea-Borne Positioning of Assets required by Sea Basing; and Battlespace Integration required by FORCEnet.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	91,665	68,540	82,623
Congressional Action	500	38,755	0
Congressional Undistributed Reductions/Rescissions	-76	-1,036	0
Execution Adjustments	-255	0	0
FY 2005 SBIR	-1,689	0	0
Program Adjustments	9	668	-3,300
Program Realignment	0	0	2,365
Rate Adjustments	0	0	347
FY 2007 President's Budget Submission	90,154	106,927	82,035

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
Efforts within this PE support the FNC program and are monitored at two levels. At the lowest level, each is measured against technical and financial milestones on a monthly basis. Annually, each FNC project is reviewed in depth for technical and transition performance by CNR against requirements approved by the Navy's senior flag level Technical Oversight Group. Routine site visits to performing organizations are conducted to assess programmatic and technical progress. Most are reviewed annually or bi-annually by an independent board of visitors who assess the level and quality of the Science and Technology basis for the project. Several of

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

these projects support specific Defense Technology Objectives established by the Director, Defense Research and Engineering (DDR&E) and receive a bi-annual technical and programmatic review under DDR&E's Technology Area Review Assessment Program.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2915 WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	55,222	61,459	82,035	113,390	105,453	108,793	116,140

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Warfighter Sustainment Advanced Technology supports Manpower and Personnel, Training, and Readiness; and the Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff. This project supports the FNC Program in Airframe/Ship Corrosion; Turbine Engine Technologies; Littoral Combat; Sea Base Planning, Operations and Logistics; and Sea Base Mobility and Interfaces. This project develops technologies that enable the Navy to better recruit, select, classify, assign, and manage its people; to train effectively and affordably in classroom settings, in simulated and actual environments, and while deployed; and to effect human systems integration into weapon systems. Other technologies enable reduced operating costs through life-extension of legacy systems, increased efficiency of future propulsion systems and improved diagnostic tools. Within the Naval Transformation Roadmap, this investment supports the achievement of all the transformational capabilities of Sea Warrior and the transformational capabilities of Ship to Objective Maneuver and Time Sensitive Strike required by Sea Strike; Littoral Sea Control and Anti-Submarine Warfare required by Sea Shield; Compressed Deployment and Employment Times and Enhanced Sea-Borne Positioning of Assets required by Sea Basing; and Battlespace Integration required by FORCEnet.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
SEA BASE PLANNING, OPERATIONS AND LOGISTICS	11,264	10,207	13,329

This activity includes support to the FNC Enabling Capabilities for Sea Base Collaborative Command and Control; Sea Base Integrated Operations; and Surface Connector Vehicle Transfer. Sea Basing will require more robust afloat command and control for sustainment activities. Logistics must integrate with the joint task

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

force common operating picture, and provide awareness of mission supportability and readiness at an operational and tactical level. This activity will produce techniques and systems to support automated transfer of cargo from shipboard unload/onload point to stowage spaces. Technologies include high-strength composites, ship-motion compensation for force control-based systems, intelligent systems, and robotics.

FY 2006 - FY 2007 increase to support planned project transitions and reflects the effects of the realignment of FNC Program investments into Enabling Capabilities.

FY 2005 Accomplishments:

- Continued focus on the shipboard automated storage and retrieval system. Commenced building land based test module.
- Continued human amplification technology under compact agile material mover and completed the proof of concept demonstrator to support further developments.
- Continued efforts of software development for the afloat component of naval sustainment Command and Control (C2).
- Initiated prototype development to handle container movement aboard ship.

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Complete automated storage and retrieval efforts with a demonstration of the land based test site and subsequent shipboard demonstration.
- Initiate concepts for high rate horizontal and vertical material movement within the Sea Base. (Previously reported under activity SEA BASE MOBILITY AND INTERFACES of this PE.)

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete efforts in human amplification technologies.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

- Complete efforts of software development for the afloat component of naval sustainment Command and Control (C2).
- Initiate efforts in interface ramp technologies for seabasing.
- Initiate efforts for improved cargo lashing/unlashing systems.

	FY 2005	FY 2006	FY 2007
SEA BASE MOBILITY AND INTERFACES	7,958	11,684	19,145

This activity includes support to the FNC Enabling Capabilities for Sea Base Mobility and Interfaces, and Maritime Preposition Force (Future) (MPF (F)) Marine Expeditionary Brigade (MEB) Force Closure. This activity improves the capability for transfer of personnel and cargo between Sea Base/Logistics vessels and unimproved beaches during high sea states. Capabilities being developed include propulsion technologies, cargo stabilization technologies, advanced hull form technologies and fabrication of lightweight robust structures needed for sustained operations at high speed in a moderate seaway. This activity further supports the Sea Basing mission of marrying troops to equipment, and providing support to seaborne forces via surface distribution interfaces. It will improve current underway replenishment capabilities for transfer of cargo between Sea Base/Logistics vessels (large ship-to-ship) during high sea states, while increasing ship separation for safety.

FY 2005 - FY 2007 increases result from the planned initiation of projects to support the Navy's developing sea basing concept of operations, to support planned product transitions to new ship programs, and to reflect the realignment of FNC Program investments into Enabling Capabilities.

FY 2005 Accomplishments:

- Continued efforts on large to large vessel lift on/lift off capability.
- Completed design studies and conducted limited prototyping and model basin testing.
- Completed work in station keeping and scale demonstrations in a relevant environment.
- Initiated technology exploration in hydrodynamic impacts and design space trade studies.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Initiate work for a beachable high speed craft as a Sea Base mobility interface.
- Initiate work in small to large at-sea vessel interfaces.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Initiate work for technology support 3rd generation individual blade control for heavy lift vertical air replacement platform.
- Initiate efforts to demonstrate large axial-flow waterjet technologies.

	FY 2005	FY 2006	FY 2007
FRICTION DRAG REDUCTION	0	0	2,497

This activity is a collaborative effort with the Defense Advanced Research Agency (DARPA) and the Program Executive Officer for Ships (PEO Ships). The objective is to unambiguously demonstrate the performance of large-scale predictive models that incorporate sufficient physics from first-principles models on a large or full-scale ship test vehicle.

FY 2006 - 2007 increase due to program start up.

FY 2007 Plans:

- Initiate design of an optimal implementation of additive-based drag reduction technology using large-scale predictive models.

	FY 2005	FY 2006	FY 2007
SEA BASING	0	5,254	9,320

This activity includes advancement of technologies to support the design and development of Sea Basing

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

Innovative Naval Prototypes. Areas include design and development of various Sea Basing prototypes in the areas of high speed, shallow draft and beachable connectors; vessel to vessel interfaces; and automated and integrated warehousing.

2005 - 2006 increase due to program start up.
2006 - 2007 increase due to initiation of further efforts.

FY 2006 Plans:

• Initiate prototype designs in the areas of high speed, shallow draft and beachable connectors; vessel to vessel interfaces; and automated and integrated warehousing.
• Initiate advanced technology development of selected Sea Basing technologies which would support prototype design. Technologies include: lift cushion seal challenges such as lightweight, high strength, long wear materials; variable geometry/retractability; sea state four capability as well as lighter weight, more efficient lift fans; automatic connector/mating systems; innovative seal systems; vertical/horizontal transition of conveyance and autonomous; and low power consumption intraship transport systems.

FY 2007 Plans:

• Continue all efforts of FY 2006.
• Initiate detailed design of Sea Basing prototypes implementing systems integration and utilizing selected technologies from FY 2006 development.
• Initiate prototype construction of selected systems of technologies from FY 2006. Technologies include: low power consumption intra-ship transport systems, autonomous vertical/horizontal transition of material conveyance systems, innovative high-rate personnel transfer systems, at-sea motion stabilization systems, and surface effect lift efficiency.
• Initiate prototype demonstration and at-sea test plans.

	FY 2005	FY 2006	FY 2007
MANPOWER AND PERSONNEL DEVELOPMENT	2,924	3,071	6,998

This activity provides Navy personnel system managers with the ability to attract and retain the right people and to place them in jobs that best use their skills, training, and experience. Application of modeling and

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

simulation, mathematical optimization, advanced testing, statistical forecasting, information visualization, data warehousing, data cleansing, web-based knowledge management, and human performance measurement technologies enhances Fleet readiness and reduces personnel costs.

FY 2006 - 2007 increase due to planned completion of integration projects vital to the Navy's "Strategy for Our People".

FY 2005 Accomplishments:

- Continued Non-Cognitive Measures of Personality and Social Competency related to teamwork, Navy adaptability, leadership, and job performance to be applied in personnel selection and classification.
- Continued Career Case Manager Technologies, which integrates intelligent agents, simulation models, and statistical methods to support Sailor/Marine career planning and decision making.
- Continued Distribution Incentive System, which incorporates the economic methods, business rules, and incentive structures to incentivize traditionally difficult-to-fill assignments or locations.
- Continued Web Based Marketplace for Sailors and Jobs, the computational operating environment in which the command, broker, and Sailor cognitive agents will interface to distribute and assign military personnel.
- Completed Attrition Reduction Technologies.
- Completed Enterprise Management System.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete Non-Cognitive Measures.
- Complete Career Case Manager Technologies.
- Complete Distribution Incentive System.
- Initiate Integrated Whole Person Assessment, which integrates Attrition Reduction Technologies, Non-Cognitive Measures, and Rating Identification Engine (RIDE)/Job and Occupational Interest in the Navy (JOIN).
- Initiate Integrated Sailor/Marine Career Management System, which integrates Career Case Manager Technologies Distribution Incentive System.
- Initiate development of advancement and retention analytical tools for Comprehensive Optimal Manpower & Personnel Analytical Support System (COMPASS), formerly titled Integrated Personnel Situational Monitoring, Analysis, and Response Technologies.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

FY 2007 Plans:

- Complete advanced development of Cultures and Values Selection for integration with other selection and classification measures.
- Complete Integrated Whole Person Assessment.
- Complete Web Based Marketplace.
- Complete Integrated Sailor/Marine Career Management System.
- Complete COMPASS.

	FY 2005	FY 2006	FY 2007
TRAINING SYSTEMS	12,965	12,484	12,045

This activity improves mission effectiveness and safety by applying both simulation and instructional technology to the design of affordable education and training methods and systems. Improved training efficiency and cost-effectiveness is achieved by applying operations research, modeling and simulation, and instructional, cognitive, and computer sciences to the logistics, development, delivery, evaluation, and execution of training.

FY 2005 - 2006 decrease due to planned completion of projects.

FY 2005 Accomplishments:

- Continued debriefing technologies.
- Continued advanced technologies for Interactive Electronic Technical Manuals.
- Continued focus on Virtual Technologies and Environments (VIRTE) Demonstration II, and performance assessment tools.
- Completed development of human performance assessment tools for Navy-wide distributed learning.
- Completed Battle Group Level Advanced Under Sea Warfare (USW) visualization systems.
- Completed alternate cockpit information display evaluations.
- Initiated VIRTE Demo III, which provides integrated virtual training across the full spectrum of combat.
- Initiated advanced technologies for collaborative network-centric visualization systems.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

• Initiated and completed architecture design for integrating Naval surface fire support and air Virtual At Sea Training technologies into a joint operations constellation that includes cross-echelon and multi-platform training.

FY 2006 Plans:

• Continue all efforts of FY 2005 less those noted as completed above.
• Complete debriefing technologies.
• Complete VIRTE Demonstration II.

FY 2007 Plans:

• Complete advanced technologies for Interactive Electronic Technical Manuals.
• Complete VIRTE Demonstration III.
• Complete advanced technologies for collaborative network-centric visualization systems.

	FY 2005	FY 2006	FY 2007
HUMAN SYSTEMS INTEGRATION	1,170	0	0

This effort supports the warfighter by designing affordable user-centered systems that are easy to use and train. Focus is on the application of a reusable user-centered design process to design a user interface to support user tasks, extract software requirements, and develop software design models.

FY 2005 - 2006 decrease due to program termination.

FY 2005 Accomplishments:

• Completed integration of Land Attack task and Human-Computer Interaction designs into Tactical Tomahawk Weapon Control System builds.
• Completed software architecture design to accommodate task-based user interface for Land Attack systems.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

	FY 2005	FY 2006	FY 2007
TURBINE ENGINE TECHNOLOGY - INTEGRATED HIGH PERFORMANCE TURBINE ENGINE TECHNOLOGY (IHPTET)/ VERSATILE AFFORDABLE ADVANCED TURBINE ENGINES (VAATE)	9,970	10,917	11,343

This activity provides integration and experimental engine testing of new gas turbine engine technologies to demonstrate readiness and reduce technical risk for entering engineering development. IHPTET is a tri-service program in which each service contributes established shares of advanced technology funding and laboratory resources to meet specified goals. This activity covers the Navy's share. The objective of VAATE is to develop and demonstrate versatile, durable, “intelligent” engine technologies for the spectrum of legacy, pipeline, and new military aircraft, rotorcraft, missiles, and unmanned air vehicles (UAVs). The VAATE goal is 10X improvement in turbine engine affordability (capability/cost) by 2017, with an interim goal of 6X by 2010.

FY 2005 Accomplishments:

- Continued Phase III Joint Turbine Advanced Gas Generator (JTAGG) development.
- Continued core test of Honeywell Engine and Systems (HES) demonstrator.
- Completed the Phase II Joint Technology Demonstrator Engine (JTDE), General Electric (GE)/Allison Advanced Development Company (AADC) demonstrator engine.
- Completed the Phase III JTDE (GE/AADC) and Pratt & Whitney (P&W) demonstrator engines.
- Initiated VAATE Phase I: Design, component development, integration and fabrication of Phase I demonstrator engines.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete the Phase III JTAGG development and final core test of HES demonstrator.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

- Initiate testing of VAATE Phase I demonstrator engines with GE and P&W.

	FY 2005	FY 2006	FY 2007
AIRFRAME/SHIP CORROSION	4,528	3,908	5,360

This activity includes an integrated approach for the control of the effects of external and internal corrosion in Naval weapon systems. The work develops advanced, cost effective prevention and lifecycle management technologies. This is particularly significant to life extension for the aging fleet.

FY 2005 - FY 2006 decrease is due to rebalancing of FNC funding.
FY 2006 - FY 2007 increase is to fund planned completions.

FY 2005 Accomplishments:

- Continued development of road test method for Marine Corps vehicles.
- Continued development of single coat system for ship tanks (fuel tanks).
- Continued the development of Nondestructive Inspection (NDI) Technology for aircraft metal and composite structures to detect cracks and defects.
- Completed aircraft corrosion effort.
- Completed single coat system for ship tanks (potable water tank) and demonstrated on 10 salt water ballast tanks.
- Completed Corrosion Preventive Compounds (CPCs) and NDI technology for corrosion detection for aircraft structures.
- Initiated the development of single coat systems for Collection-Holding-Transfer (CHT) ship tanks.
- Initiated NDI technology for heat damage detection on composite materials.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete single coat system for ship tanks (fuel tank) and demonstrate coatings on fuel tanks.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete road test methodology.
- Complete development of NDI technology for metals, composites and structures.
- Complete single coat system for ship tanks (CHT tank).

	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT	4,443	3,934	1,998

The goal of Littoral Combat is the application of technologies to enhance the ability of the Navy/Marine Corps team to execute the Naval portion of a joint campaign in the littorals. This activity considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR), fires, maneuver, sustainment, force protection, and training. This activity includes support to the FNC Enabling Capabilities for: Reduce Support Costs 1, Advanced Naval Fires Technology Spiral 1, Combatant Commander (COCOM) to Marine Combat Identification (ID), Global Information Grid (GIG)-Compliant Networking, Hostile Fire Detection and Response Spiral 2, Position-Location-Information, Reduce Cost of Operations 1, Sea Base Collaborative Command and Control, Sea Base Mobility and Interfaces, and Sea Base Integrated Operations.

The funding profile from FY 2006 to FY 2007 reflects the reorganization of the FNC Program investments into Enabling Capabilities (EC). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This activity reflects the alignment of investments for the following EC: Battlefield Power.

FY 2005 Accomplishments:

- Continued development of Phase 1 of the Position Location Information (PLI) system technology development.
- Continued development of innovative relays for Beyond Line of Sight (BLOS) communications.
- Continued integration and demonstration of secure mobile network/wireless LAN technologies.
- Continued development effort for Organic Light Emitting Diode (OLED) display technologies.
- Continued development of a capability to rapidly generate a terrain database.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

- Continued modeling and testing of the advanced weapon materials technology efforts on the Expeditionary Fires Support System (EFSS) artillery and mortar systems.
- Continued development of advanced target acquisition (target hand off and target location) technologies for both mounted and dismounted applications. (Previous efforts funded by PE 0603782N)
- Continued development and integration of improved fire control systems for direct and indirect fire weapons. (Previous efforts funded by PE 0603640M)
- Initiated development of technology to enhance navigation in a Global Positioning System (GPS) denied environment.
- Initiated development of integrated vehicle self-defense system to defeat incoming Rocket Propelled Grenades (RPGs).

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Continue development of lightweight computational fire control interface technology. (Previous effort funded by PE 0603782N; FY07 effort to be funded by PE 0603782N)
- Complete Phase 1 of the PLI system technology development.
- Complete development effort for OLED display technologies.
- Complete development of and transition a capability to rapidly generate a terrain database.
- Initiate Phase 2 of the PLI system technology development.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Initiate development of lunchbox sized 500 – 1000W portable JP-8 fueled generator.

The following efforts transition in FY 2007 from PE 0603236N to various PEs as follows:

- Continue development of integrated vehicle self-defense system to defeat incoming RPGs. (realigned to PE 0603640M)
- Continue development of technology to enhance navigation in a GPS denied environment. (realigned to PE 0602131M)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

- Complete integration and demonstration of secure mobile network/wireless LAN technologies. (realigned to PE 0602131M)
- Complete testing of the advanced weapon materials technology efforts on the EFSS artillery and mortar systems. (realigned to PE 0602114N)
- Complete development and transition of advanced naval fires target acquisition technologies. (realigned to PE 0602114N)

C. OTHER PROGRAM FUNDING SUMMARY:
RELATED RDT&E:

NAVY RELATED RDT&E:
PE 0206624M - Marine Corps Combat Services Support
PE 0601103N - University Research Initiatives
PE 0601152N - In-House Laboratory Independent Research
PE 0601153N - Defense Research Sciences
PE 0602123N - Force Protection Applied Research
PE 0602236N - Warfighter Sustainment Applied Research
PE 0603512N - Carrier Systems Development
PE 0604703N - Personnel, Training, Simulation, and Human Factors
PE 0605013M – Information Technology Development
PE 0605152N - Studies and Analysis Support - Navy

NON NAVY RELATED RDT&E:
PE 0601102A - Defense Research Sciences
PE 0602211A - Aviation Technology
PE 0603003A - Aviation Advanced Technology
PE 0603007A - Manpower, Personnel and Training Advanced Technology
PE 0601102F - Defense Research Sciences
PE 0602203F - Aerospace Propulsion
PE 0603216F - Aerospace Propulsion and Power Technology

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 3008 PROJECT TITLE: HIGH SPEED SEALIFT VESSEL

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
3008 HIGH SPEED SEALIFT VESSEL	2,589	668	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Within the Naval Transformation Roadmap, this investment supports the achievement of Compressed Deployment and Employment Times and Enhanced Sea-Borne Positioning of Assets required by Sea Basing.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
HIGH SPEED VESSEL	2,589	668	0

Within the Naval Transformation Roadmap, this investment supports the achievement of Compressed Deployment and Employment Times and Enhanced Sea-Borne Positioning of Assets required by Sea Basing.

FY 2005 Accomplishments:

Completed development of large composite test articles initiated in FY 2003 under the Composite High Speed Vessel program.

FY 2006 Plans:

Complete replacement of lost and damaged materials for the composite High Speed Vessel caused during Hurricane Katrina.

C. OTHER PROGRAM FUNDING SUMMARY:
0601153N - Defense Research Sciences
0602123N - Force Protection Applied Research

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 3008 PROJECT TITLE: HIGH SPEED SEALIFT VESSEL

0603123N - Force Protection Advanced Technology
0603758N - Navy Warfighting Experiments and Demonstrations

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ASPHALT RECONDITIONER	1,646	0

This effort facilitated the application of GSB-88, which is a complex asphalt emulsion product specifically engineered to retard surface oxidation of asphalt pavement; monitored the performance of GSB-88 to prevent premature oxidation and corrosion of the asphalt infrastructure; and assessed cost savings in asphalt preservation cost.

	FY 2005	FY 2006
AUTOMATED CONTAINER AND CARGO HANDLING SYSTEM	1,928	2,000

FY 2005 - This effort designed, fabricated, and tested a full scale active AutoLog spreader bar system for lifting containers and cargo while at sea.

FY 2006 - This effort supports automated container and cargo handling system research.

	FY 2005	FY 2006
AUTONOMOUS SUSTAINMENT CARGO CONTAINER DELIVERY SYSTEM	0	1,000

This effort supports autonomous sustainment cargo delivery system research.

	FY 2005	FY 2006
CAFFING PROTECTION SYSTEM	1,357	0

This effort developed and transitioned a condition based monitoring technology for onboard detection, diagnostics, and prognostics of wire chaffing onboard Navy aircraft. The main tasks were to flight test a current prototype onboard an H-53 helicopter, and to enhance a previously developed prototype by increasing its sensitivity and reducing the interrogation time. Decaying, aged wiring is an insidious and usually unseen problem to aircraft maintainers and operators. With most aircraft wiring hidden from view, an enabling

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

technology to detect wiring faults prior to electrical malfunction is urgently needed. Wiring defects are most often initially manifested by chaffing, followed by cumbersome, costly and time consuming repair.

	FY 2005	FY 2006
CRREST SKILL SET ANALYSIS	0	5,100

This effort supports CRREST skill set analysis research.

	FY 2005	FY 2006
CURVE PLATE TECHNOLOGY	0	1,000

This effort supports curve plate technology research.

	FY 2005	FY 2006
DAMAGE CONTROL ONBOARD SIMULATION	0	2,600

This effort supports damage control onboard simulation research.

	FY 2005	FY 2006
DEFENSE SYSTEMS MODERNIZATION AND SUSTAINMENT INITIATIVE	3,861	3,000

FY 2005 - The Asset Health Management area expanded from a single vehicle to the fleet level through co-funding with the Marine Corps Warfighting Laboratory. Integration of the system into Intelligent Maintenance began. Prognostic sensing and assessment technologies were expanded to electronic components. The effort developed the required reverse engineering/restoration technology for critical legacy components for ground and air vehicles.

FY 2006 - This effort supports defense systems modernization and sustainment initiative research.

	FY 2005	FY 2006
EXPEDITIONARY CRAFT	0	9,000

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

This effort supports expeditionary craft research.

	FY 2005	FY 2006
EXPEDITIONARY LOGISTICS FOR THE 21ST CENTURY (EXLOG21)	2,893	0

This effort completed the Material Control Officer (MATCONOFF) software development and transitioned the product to the Space and Warfare Systems Office, PMW 151.

	FY 2005	FY 2006
HEET	4,822	4,500

FY 2005 - Note: This effort was previously titled "Energy and Environmental Technology".

This effort continued its partnership with the Naval Research Laboratory to test and develop advanced fuel cell systems for military and civilian application, and to explore and characterize sea-floor methane hydrates as a potential fuel source. The fuel cell activity focused on the development of strong industrial partnerships for providing access to state-of-the-art-fuel cells, and the use of the laboratory facility to characterize the performance and durability of cells and cell components for Navy applications.

FY 2006 This effort supports HEET research.

	FY 2005	FY 2006
INTEGRATED ASYMMETRIC URBAN WARFARE	0	1,000

This effort supports integrated asymmetric urban warfare research.

	FY 2005	FY 2006
INTEGRATED VEHICLE HEALTH MANAGEMENT SYSTEM	2,514	0

Note: This effort was previously titled "Integrated Aircraft Health Management".

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

This effort demonstrated data interoperability software tools and diagnostic algorithms on F/A-18 E/F flight control actuators and propulsion system, as well as selected C-17, V-22 and/or commercial platform systems. The technology will enable reduced operating costs through life-extension of legacy systems and will enable improved diagnostic tools that will decrease the number of unnecessary parts removals.

	FY 2005	FY 2006
INTELLIGENT WORK MANAGEMENT	1,640	1,700

FY 2005 - This effort developed network technologies to significantly increase the speed and efficiency by which shipboard maintenance problems are identified, replacement parts are located, and maintenance personnel are assigned to address the problems.

FY 2006 - This effort supports intelligent work management research.

	FY 2005	FY 2006
LOW VOLUME PRODUCTIVITY	1,446	0

This effort established a laser repair facility which is fully robotic and which uses a higher power laser than was previously available. Such a facility enables the economical repair of shipboard components which are likely to reach a navy repair facility in very small numbers (frequently "one of a kind").

	FY 2005	FY 2006
MINE WARFARE TECHNOLOGY SOLUTIONS (MWTS)	2,507	0

This effort supported the development of metrics; analysis tools; and the assessment engineering concepts, processes, systems, and technologies for mine countermeasures missions. This effort emphasized the use of unmanned surface vehicles for mine countermeasures missions.

	FY 2005	FY 2006
MOTION-COUPLED VISUAL ENVIRONMENT (MOCOVE)	0	1,000

This effort supports Motion-Coupled Visual Environment (MOCOVE) research.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
NADEP CHERRY POINT CTR FOR VERTICAL LIFT AIRCRAFT REPAIR AND MAIN. TECH PRG	1,933	0

This effort provided for science and technology insertion into a dedicated activity to identify, demonstrate, validate, and assist in implementing improved maintenance products, procedures, and processes into depot operations. The payoff of these technology advancements will be increased readiness by improving maintenance operations and decreasing maintenance cycle times for rotary wing aircraft.

	FY 2005	FY 2006
ONR VIRTUAL AT SEA TRAINING INITIATIVE	964	1,500

FY 2005 - This effort extended the Virtual At Sea Training (VAST) system to new warfighting arenas including battlegroup level Anti-submarine Warfare training and mission rehearsal, and Marine Corps indirect fire weapons training for the full artillery team.

FY 2006 - This effort supports the ONR Virtual at Sea Training Initiative.

	FY 2005	FY 2006
PHOTONIC MACHINING OF ELECTRONIC MATERIALS	0	1,000

This effort supports photonic machining of electronic materials research.

	FY 2005	FY 2006
PRECISION FABRICATION OF LARGE CURVED STEEL NAVY SHIP STRUCTURES	1,939	0

This effort used precision fabrication of large curved steel beams in the application of new concepts of hybrid stainless steel/composite construction to Navy ship structures. Hybrid ship construction will provide low magnetic signatures, increased survivability, low maintenance, and light weight for high speed ships for Littoral Combatant Ship applications. Application of precision fabrication using computer controlled welding

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

and metrology to control weld distortions are key to low cost manufacturing.

	FY 2005	FY 2006
PROTECTIVE APPAREL TECHNOLOGY SYSTEMS	0	3,000

This effort supports protective apparel technology systems research.

	FY 2005	FY 2006
SEAPRINT	1,446	4,200

FY 2005 - Note: This effort was previously titled "IMPRINT".

Based on previously tested Human Systems Integration (HSI) specifications adopted from Army MANPRINT technology, this effort included additional test platforms to ascertain performance outcomes: controlling for cognitive and non-cognitive factors for each test subject group. Also there was an inclusion of meta-heuristic optimization algorithms to ascertain optimal performance outcomes subject to varying HSI tenets and test platforms.

FY 2006 - This effort supports SEAPRINT research.

	FY 2005	FY 2006
SHIPBOARD PERSONAL LOCATOR BEACON	0	1,100

This effort supports shipboard personal locator beacon research.

	FY 2005	FY 2006
ULTRASONIC CONSOLIDATION OF MATRIX COMPOSITES	964	0

This effort researched new composite materials to be used in advanced munitions.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
VIGILANT NETWORK CENTRIC SECURITY DATA SYSTEM	483	0

This effort developed a computer security system for DoD wide application that provides an automatic identification access control and personnel tracking capability.

	FY 2005	FY 2006
WIRELESS SENSORS FOR NAVY AIRCRAFT	0	2,100

This effort supports research of wireless sensors for Navy aircraft.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N
PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	63,204	100,982	45,317	2,627	26,782	26,357	25,974
2913 RF SYSTEMS ADVANCED TECHNOLOGY	35,811	73,932	45,317	2,627	26,782	26,357	25,974
9999 CONGRESSIONAL PLUS-UPS	27,393	27,050	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) addresses technologies critical to enabling the transformation of discrete functions to network centric warfare which utilizes multiple, simultaneous and continuous communications/data links between platforms while simultaneously performing the functions of Electronic Warfare (EW) and radar surveillance. The Radio Frequency (RF) Systems Advanced Technology Program addresses RF technology for Surface and Aerospace Surveillance Sensors and systems, EW sensors and systems, RF Communication Systems, and Multi-Function sensor systems. The Program emphasizes near to mid-term transition opportunities by developing and demonstrating technologies supporting the Future Naval Capabilities (FNC) Program Enabling Capabilities (ECs) for Multi-Source ISR to the Warfighter and Advanced Electronic Sensor Systems for Missile Defense. Within the Naval Transformational Roadmap, this investment will achieve transformational capabilities required by: “Sea Shield” Theater Air and Missile Defense; as well as technically enable “Sea Strike” Persistent Intelligence, Surveillance, and Reconnaissance.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N
PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	71,743	75,070	50,041
Congressional Action	0	27,050	0
Congressional Undistributed Reductions/Rescissions	-55	-1,138	0
Execution Adjustments	-7,092	0	0
Federal Technology Transfer	-34	0	0
FY 2005 SBIR	-1,366	0	0
Program Adjustments	8	0	0
Program Realignment	0	0	-4,809
Rate Adjustments	0	0	85
FY 2007 President's Budget Submission	63,204	100,982	45,317

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
Performance Metrics are discussed within the R-2a.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: 2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2913 RF SYSTEMS ADVANCED TECHNOLOGY	35,811	73,932	45,317	2,627	26,782	26,357	25,974

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Radio Frequency (RF) Systems Advanced Technology project addresses technologies critical to enabling the transformation of discrete functions to network centric warfare which utilizes multiple, simultaneous and continuous communications/data links between platforms while simultaneously performing the functions of Electronic Warfare (EW) and radar surveillance. Work in this project addresses RF technology for Surface and Aerospace Surveillance sensors and systems, EW sensors and systems, RF Communication Systems, and Multi-Function sensor systems. The project emphasizes near to mid-term transition opportunities by developing and demonstrating technologies which enable options for Time Critical Strike, Missile Defense, Fleet Force Protection, and Knowledge Superiority and Assurance Future Naval Capabilities (FNCs). Within the Naval Transformational Roadmap, this investment will achieve transformational capabilities required by: “Sea Shield” Theater Air and Missile Defense; as well as technically enable “Sea Strike” Persistent Intelligence, Surveillance, and Reconnaissance.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
ADVANCED MULTI-FUNCTION RF TECHNOLOGY	18,199	43,126	45,317

This effort develops, demonstrates, and transitions wideband, high performance multifunction Radio Frequency (RF) apertures capable of transmitting and receiving multiple, simultaneous, independent RF beams while providing reduced signature and numbers of apertures. Program goals include development and demonstration of multi functional RF technology applicable to systems development for DD(X) and other ship classes that will provide reduced recurring costs for total system functionality; reduced number of topside antennas and support systems; reduced ship radar cross section; reduced number of unique spares and lower ship manning requirements; provide ability to upgrade systems and capabilities with reduced cost, time, and complexity while mitigating the risk of obsolescence; and provide ability to rapidly exploit technological innovation

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: 2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

through open systems concepts.

Major objectives include multi function concept development, testing, and technology demonstration of communications, electronic attack, electronic surveillance, and radar functions within the AMRF-Concept (AMRF-C) Test Bed; development of a Multi Function Electronic Warfare/Electronic Surveillance (support) (MFEW/ES) Advanced Development Model (ADM) for DD(X) that demonstrates key Electronic Warfare Support (ES) capabilities for several simultaneous ES functions; development of an MFEW/ES ADM architecture that is capable of supporting additional RF functions; and conducting MFEW/ES ADM testing that satisfies DD(X) program Technology Development (TD) Phase requirements to enable a smooth transition of AMRF technology to the DD(X) System Development and Demonstration (SDD) Acquisition Phase with minimal changes in system architecture.

AMRF Systems Technology developments directly support the Department of Defense Joint Warfighter Science and Technology Plan and the Defense Technology Area Plans.

This activity also addresses the following capabilities:
Digital Array Radar S&T develops open architecture digital beamforming and digital transmit and receive capability for CG(X).

Electronic Attack (EA) Techniques maintain effective countermeasures in the face of increasingly sophisticated Naval threats.

Shipboard EO/IR Closed Loop Self-Protection develops Shipboard Integrated Electro-optic Defense System (SHIELDS) hardware which includes a Mid-wave IR (MWIR) camera operating in the 2-5 um wavelength spectral band. This effort was previously funded in PE 0603123N.

Littoral Affordability is a classified program.

FY 2005 to FY 2006 increases due to FNC MFEW/ES.

The funding profile from FY06 to FY07 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Multi-Source ISR to the Warfighter and Over-The-Horizon Missile Defense.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: 2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

FY2005, FY2006, and FY2007 budget growth is attributed to addition (from COMMUNICATIONS AND ELECTRONICS activity) of EA Techniques, Littoral Affordability, and Affordable Ground Based Radar; the addition of new start S-Band DAR, and the addition of EO/IR Closed Loop Self-Protection from PE 0602123N.

FY 2005 Accomplishments:

- Continued the MFEW/ES Program Technology Development Phase.
- Continued operation of the wideband multi-function Communications and EW testbed in support of multi-function system development and multi-function technology insertion and demonstration for the AMRF-C effort.
- Continued MFEW/ES Core Software Development.
- Continued Shipboard EO/IR Closed Loop Self-Protection effort. Effort was moved into this activity from PE 0603123N.
- Completed ADM testing of the AGBR project in time to support Marine Corps Milestone B decision on the GATOR MRRS program in mid-FY 2005.
- Initiated development of a High Band array antenna capable of simultaneously supporting multiple Electronic Support Measures (ESM) surveillance functions for the MFEW/ES ADM, providing 4 high gain high sensitivity Electronics Support Measures beams.
- Initiated development of a Mid Band array antenna capable of simultaneously supporting multiple ESM functions for the MFEW/ES ADM.
- Initiated development of back-end analog receiver equipment supporting MFEW/ES ADM.
- Initiated systems integration, risk reduction, and Navy critical subsystem development effort leading to demonstration of MFEW/ES ADM in a relevant environment and support MFEW/ES hardware/component testing within the AMRF-C testbed.
- Initiated development of S-band Digital Array Radar, enabling simultaneous SBT and AAW missions.
- Initiated and completed a segment of the Missile Defense FNC Littoral Affordability effort (classified program).
- Initiated the Advanced Technology Development phase of the EA Techniques to Counter Advanced Threats effort by commencing laboratory demonstration of synthetic sea clutter EA waveforms with a timing resolution of 20 nanoseconds.
- Initiated development of a Real Time PS&T Radar, providing 360 degree maritime surveillance.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: 2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

• Complete the integration and testing of the Real Time PS&T Radar, providing 360 degree maritime surveillance.

FY 2007 Plans:

• Continue all efforts of FY 2006 less those noted as complete above.
• Complete the MFEW/ES Program Technology Development Phase. Demonstrate 4 beams/band operations on ADM, with following functionality:
• Complete MFEW/ES Core Software Development.
• Complete development of a High Band array antenna capable of simultaneously supporting multiple ESM surveillance functions for the MFEW/ES ADM.
• Complete development of a Mid Band array antenna capable of simultaneously supporting multiple ESM functions for the MFEW/ES ADM.
• Complete development of back-end analog receiver equipment supporting MFEW/ES ADM.
• Complete systems integration, risk reduction, and Navy critical subsystem development effort leading to demonstration of MFEW/ES ADM in a relevant environment and support MFEW/ES hardware/component testing within the AMRF-C testbed.
• Initiate Shipboard EW Improvement and Electronic Attack (EA) Transmitter projects to develop Electronic Warfare/Electronic Attack capability for rapid technology insertion into DD(X) and other ship classes utilizing MFEW/ES ADM components and architecture and AMRF-C testbed technology. Demonstrate capability to support 4 beams/band transmit functions.
• Complete development of S-band Digital Array Radar components development.
• Complete the EA Techniques to Counter Advanced Threats effort by conducting field testing of the Coherent EA Advanced Techniques Generator (ATG) and Digital Radio Frequency Memory (DRFM) Hardware containing a field programmable gate array (FPGA) development board that is capable of operating at 200 MHz.
• Complete the Shipboard EO/IR Closed Loop Self-Protection effort by final at-sea demonstration of the Shipboard Integrated Electro-optic Defense System (SHIELDS) hardware which includes a Mid-wave IR (MWIR) camera operating in the 2-5 um wavelength spectral band.

	FY 2005	FY 2006	FY 2007
ELECTRONICS AND COMMUNICATIONS TECHNOLOGIES	17,612	30,806	0

The funding profile from FY06 to FY07 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: 2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following FORCEnet ECs: Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets, GIG-Compliant Networking, Advanced Communication for FORCEnet, and Marine and UxV Tactical ISR.

Beginning in FY07, the following projects previously reported within the ELECTRONICS and COMMUNICATIONS TECHNOLOGIES activity are aligned with the SEA SHIELD FNC EC, and have accordingly moved to the ADVANCED MULTI-FUNCTION RF TECHNOLOGY activity under this PE: S-Band Digital Array Radar (DAR), EA Techniques to Counter the Advanced Threat, Littoral Affordability, and Affordable Ground Based Radar.

FY 2005 to FY 2006 increase due to transfer of the High Altitude Relay from 0602235N; and FY 2006 to FY 2007 decrease due to planned completion of FNC efforts.

FY 2005 Accomplishments:

- Completed Real Time Composite Networking and transition to Advanced Digital Networking System (PMW-173).
- Completed development of X/Ku band phased array antenna, providing > 100 Mbps within 3 degree beamwidth.
- Initiated development of Ultra High Frequency (UHF)/L Band Phased Array Antennas for Carrier Vessel Nuclear (CVN), to provide 16-20 JTRS compliant communications beams within CVN RCS requirements.
- Initiated development of a Real Time Precision Surveillance Targeting (PS&T) Radar.
- Initiated Airborne Communications Package and complete airborne testing.
- Initiated advanced development of Next Generation Communication at Speed and Depth (NGCSD), 2400 bps throughput.
- Initiated demonstration and performance optimization of the Integrated, Very High, Ultra High Frequency, L Band (IVUL) prototype antenna, meeting DD(X) RCS with -20 to -30 dB intermod products.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete the integration of the PS&T radar system and conduct initial flight testing aboard the P-3C flight test Aircraft.
- Complete development of NGCSD, 2400 bps throughput; effort transfers to PMW 770 Submarine Integrated Antenna System (SIAS).
- Complete demonstration and performance optimization of the Integrated, Very High, Ultra High Frequency, L

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: 2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

Band (IVUL) prototype antenna, meeting DD(X) RCS with -20 to -30 dB intermod products.
• Complete the integration and testing of the Real Time Precision Surveillance Targeting Radar, providing 360 degree maritime surveillance.
• Continued development of Ultra High Frequency (UHF)/L Band Phased Array Antennas for Carrier Vessel Nuclear (CVN), to provide 16-20 JTRS compliant communications beams within CVN RCS requirements. FY07 work will continue in PE 0603235N.
• Initiate and complete Airborne Communications Package and transition to FIRESCOUT UAV (PMA-263), providing 3-beam TCDL out to greater than 80 nautical miles. (FY05 work was funded under PE 0602235N.)
• Initiate development of High Altitude Airborne Relay and Router Package to deliver multi-beam relay/router and high altitude (>65,000ft) capability across UHF, VHF, L and Ku bands with > 200 nm footprint. Work was funded in PE 0602235N in FY05; FY07 work will continue under PE 0603235N.

FY 2007 Plans:

• No further efforts in this activity.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0204152N (E-2 Squadrons)
PE 0601153N (Defense Research Sciences)
PE 0602271N (RF Systems Applied Research)
PE 0602123N (Force Protection Applied Research)
PE 0603123N (Force Protection Advanced Technology)
PE 0602235N (Common Picture Applied Research)
PE 0603235N (Common Picture Advanced Technology)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))

NON-NAVY RELATED RDT&E: Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
APY-6 REAL TIME PRECISION TARGETING RADAR	2,413	2,000

FY 2005 - This effort developed additional maritime modes and software for the APY-6 baseline. The Navy has a particular interest in "image while scan" and periscope detection modes. This included a high altitude data collection of sea clutter, to develop detection algorithms, and integrate "image while scan" processing.

FY 2006 - This effort supports APY-6 real time precision targeting radar research.

	FY 2005	FY 2006
C-BAND ACTIVE ARRAY RADAR (CBAAR)	6,173	12,750

FY 2005 - This effort developed affordable Transmit and Receive modules and radar at C-Band for small ships, where high performance S and X band arrays are not required.

FY 2006 - This effort supports CBAAR research.

	FY 2005	FY 2006
COMMON AFFORDABLE RADAR PROCESSOR	7,426	6,800

FY 2005 - This effort replicated and scaled the baseline Data Distribution Module (DDM) and demonstrated row and column integration and scalability for the S-band radar digital beam forming application.

FY 2006 - This effort supports common affordable radar processor research.

	FY 2005	FY 2006
HIGHLY MOBILE TACTICAL COMMUNICATIONS	2,893	2,600

FY 2005 - This effort developed the technology to provide a scalable networking demonstration for integrating

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

military tactical radios (SINCGARS, EPLRS) with small form factor, ruggedized Iridium satellite handsets in order to provide over-the-horizon communications for Marine Corps warfighters. The focus was on the scalability of this networking technology in a realistic test environment with a large number of nodes in order to more accurately assess performance and future product suitability.

FY 2006 - This effort supports HMTC research.

	FY 2005	FY 2006
HORIZON EXTENSION SURVEILLANCE SYSTEM	2,026	1,400

FY 2005 - This effort developed a UAV based radar for extending the detection horizon against sea skimming missiles.

FY 2006 - This effort supports HESS research.

	FY 2005	FY 2006
JOINT ELECTRONIC ATTACK UNMANNED VEHICLES	0	1,500

This effort supports Joint Electronic Attack Unmanned vehicles research.

	FY 2005	FY 2006
MINIATURE AUTOMATIC FUSION SPLICER	964	0

This effort developed an automated splicer for military fiber optic cables onboard ships, aircraft, and land bases. The technology developed electronic video image processing to perform automatic alignment and high voltage spark fiber optic welding to precisely align and fuse the optical fibers automatically.

	FY 2005	FY 2006
PHOTONICS PROTOTYPING FACILITY	4,052	0

This effort developed a prototyping process technology needed to fabricate prototype photonic integrated circuitry for military and commercial requirements.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
REMOTE OCEAN SURVEILLANCE SYSTEM (ROSS)	1,446	0

This effort developed and demonstrated an operational high resolution, multispectral camera for the detection and classification of underwater objects.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	128,818	88,108	59,170	62,853	59,205	59,898	61,104
2223 MARINE CORPS ATD	48,140	20,449	24,088	25,249	25,766	25,724	26,152
2297 CMC WARFIGHTING LAB CORE	50,520	35,059	35,082	37,604	33,439	34,174	34,952
9999 CONGRESSIONAL PLUS-UPS	30,158	32,600	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: As the land warfare component of Naval Expeditionary Forces, the Marine Corps has unique and technologically stressing requirements resulting from its amphibious mission, Marine Air-Ground Task Force (MAGTF) organizational structure, reliance on maneuver, logistic sustainability, and intensive tempo of operations in diverse environments. Critical Marine Corps requirements addressed in this program element (PE) are Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR); Maneuver; Logistics; Human Performance, Training and Education; and Firepower. These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in an operational environment. Multiple transitions into the Sub-system/Component Advanced Development phase are planned, as well as fieldable prototyping to reduce risk in System Concept Development and Demonstration. Joint service efforts are in line with Defense Technology Objectives (DTOs) and Joint Warfighting Objectives (JWOs). In addition, Marine Corps operational experimentation, warfighting concept experimentation, and conceptual operational assessment of emerging technologies are funded. Specifically, this PE supports the following capabilities: promptly engaging regional forces in decisive combat on a global basis; responding to all other contingencies and missions in the full spectrum of combat operations (high, mid, and low intensity), in Urban Operations in the Global War on Terrorism (GWOT), and warfighting experimentation. This PE supports all of the Marine Corps mission areas. Within the Naval Transformation Roadmap, this investment will achieve one of three key transformational capabilities required by Sea Shield as well as technically enable the Ship

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)

to Objective Maneuver (STOM) and persistent Intelligence, Surveillance and Reconnaissance (ISR) key transformational capabilities within Sea Strike and the enhanced Sea-borne Positioning of Joint Assets within Sea Basing.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	88,239	56,434	58,833
Congressional Action	0	32,600	0
Congressional Undistributed Reductions/Rescissions	-69	-926	0
Execution Adjustments	9,467	0	0
FY 2005 SBIR	-2,037	0	0
GWOT Counter IED Efforts	33,208	0	0
Program Adjustments	10	0	0
Rate Adjustments	0	0	337
FY 2007 President's Budget Submission	128,818	88,108	59,170

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Project 2297, Marine Corps Warfighting Laboratory (MCWL): Worldwide contingency operations (i.e. Operation Iraqi Freedom (OIF) campaigns, humanitarian efforts, and others) have increased the operations tempo of United States Operating Forces to the extent that their support of and participation in the MCWL Advanced Warfighting Experiments (AWEs) Sea Viking 2004 and 2006 was substantially reduced. Events have been rescheduled and adjusted so that operational assessments may be conducted by operational units preparing to deploy to Iraq and subsequently in Iraq in order to accommodate troop availability.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The primary objective of this PE is the development of technologies to meet unique Marine Corps needs in

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)

conducting Expeditionary Maneuver Warfare. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2223 PROJECT TITLE: MARINE CORPS ATD

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2223 MARINE CORPS ATD	48,140	20,449	24,088	25,249	25,766	25,724	26,152

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Critical Marine Corps requirements/imperatives addressed in this Project are: Maneuver; Firepower; Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR); Logistics; Human Performance, Training and Education. These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in an operational environment. Multiple transitions into the Sub-system/Component Advanced Development Phase are planned, as well as fieldable prototyping to reduce risk in System Concept Development and Demonstration. A tactically effective Mine Countermeasures (MCM) capability is necessary if Maneuver on land is to become a functional component of Naval Expeditionary Maneuver Warfare (EMW). Maneuver, supported by MCM provides synchronization and speed of detection, breaching, clearance, proofing, and marking operations. This project supports: 1) engaging regional forces in decisive combat on a global basis; 2) responding to all other contingencies and missions in the full spectrum of combat operations (high, middle, and low intensity), in Military Operations in Urban Terrain (MOUT), and in Operations other than War (OOTW); 3) and warfighting experimentation. By providing the technologies to enable these capabilities, this project supports the goals and objectives of the Strike, Littoral Warfare and Surveillance Joint Mission Areas. These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in an operational environment.

In addition, this project supports the goals and objectives of the Littoral Combat/Power Projection Future Naval Capability (FNC). Through 2005 the focus of the FNC efforts has been on satisfying technology gaps related to Power Projection and Littoral Combat. As the products of these efforts are transitioned to acquisition programs of record, the focus of the FNC within this PE in FY 2006 and beyond will be on technology related to Urban, Asymmetric, and Expeditionary Operations (UAEO). The UAEO Capability Gap is a science and technology developmental area that is of the highest importance to Marine Corps operations in Iraq and Afghanistan. The UAEO Capability Gap is one of 25 prioritized Capability Gaps (prioritized by OPNAV N-6/7 and the Marine Corps Combat Development Command (MCCDC)) that are made up of Enabling Capabilities (ECs) and supporting products. The UAEO technology gap is being pursued as part of an overall effort that addresses the Sea Strike Capability Gap.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2223 PROJECT TITLE: MARINE CORPS ATD

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
NIRF PROGRAM	17,092	0	0

The program details are at a higher level of classification.

	FY 2005	FY 2006	FY 2007
MANEUVER	13,857	7,015	6,874

The Maneuver Thrust Technology Area focuses on the development, demonstration, and transition of technologies that will increase the warfighting capabilities and effectiveness of current and future Marine Corps maneuver systems. This Thrust aims at capturing emerging and “leap ahead” technologies in the areas of mobility, materials, propulsion, survivability, durability, signature reduction, modularity, and unmanned systems. Beginning in FY 2008, Mine Countermeasures (MCM) will become a separate activity. Presently, MCM supports and enhances the maneuver and force protection Marine landing forces with the development of technologies to enable detection, neutralization, breaching, and clearing of mines, Improvised Explosive Devices (IEDs), and unexploded ordnance (UXO) from the beach exit to inland objectives. MAGTF MCM is a functional component of Naval Expeditionary Maneuver Warfare and includes STOM, Expeditionary Operations from a Sea Base, sustained Operations Ashore, Urban and Asymmetric Operations, and Operations other than War (OOTW).

FY 2005 reflects funding provided for efforts associated with the GWOT, specifically, Counter IED efforts such as Neutralization of IED's with RF (NIRF).

FY 2005 Accomplishments:

- Continued exploration of methods to compensate for the inhomogeneous Radio Frequency (RF) field of surface coils, for optimizing Signal to Noise Ratio (SNR) for varying inspection depths.
- Continued to improve Radio Frequency Interference (RFI) mitigation techniques and hardware, by considering coil designs, alternate RFI reference antenna designs, correlation between channels, and mitigation algorithms.
- Continued extension of characterization to a broader range of TNT sources, and to tetryl.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2223 PROJECT TITLE: MARINE CORPS ATD

- Initiated and completed comparative testing of the effectiveness of the DEMETER II magnetic signature duplication system to previously evaluated systems. The comparative analysis and technological readiness report of magnetic signature duplication systems were transitioned to Program Manager Engineers, Marine Corps Systems Command.
- Continued integration of Nuclear Quadrapole Resonance (NQR) technology with Ground Penetrating Radar (GPR) and Electromagnetic Induction (EMI) technologies for an orthogonal detector as part of a transition from PE 0602131M.
- Initiated and completed testing of the effectiveness of the DEMETER II magnetic signature duplication system.
- Initiated Advanced Electronically Controlled Active Suspension System (ECASS) development efforts for High Mobility Multi-Purpose Wheeled Vehicle (HMMWV) and future USMC vehicles.

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Continue Advanced ECASS development in support of HMMWV, MAGTF Expeditionary Family of Fighting Vehicles and other Light Armored Vehicles.
- Complete NQR technology integration efforts with GPR and EMI sensors.
- Initiate S&T programs to address MAGTF Land MCM Master Plan capability gaps.
- Initiate development of data and video transmission technology for unmanned ground vehicles.
- Initiate Electromagnetic Non-Explosive Reactive Armor (E-NERA) and Advanced Electromagnetic Armor (A-EMA) technology development efforts.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Initiate advanced armor concept development for current and future Marine Corps platforms from the 6.2 program, PE 0602131M.
- Initiate development of a Combat S&T vehicle prototype to enhance crew survivability and vehicle fuel efficiency.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2223 PROJECT TITLE: MARINE CORPS ATD

	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT/POWER PROJECTION (LC/PP)	5,298	2,838	3,623

The goal of the LC/PP FNC is to support the development of Naval Expeditionary Maneuver Warfare via the application of technologies which enhance the ability of the Navy-Marine Corps team to achieve assured access and sustained operations in the littorals as the naval portion of a Joint campaign. By being assigned S&T responsibility for littoral combat, the LC/PP FNC has been given an expansive warfighting problem set. The littoral region is where the future fight will take place and requires a broad naval perspective in identifying and solving capability gaps. In identifying capability gaps, the LC/PP FNC considers all the critical warfighting functions: Command, Control, Intelligence, ISR, Fires, Maneuver, Sustainment, and Force Protection. As the products of these efforts are transitioned to acquisition programs of record, the focus of the FNC within this PE in FY 2006 and beyond will be on technology related to Urban, Asymmetric, and Expeditionary Operations (UAEO). The UAEO Capability Gap is a science and technology developmental area that is of the highest importance to Navy and Marine Corps operations in Iraq and Afghanistan. The UAEO Capability Gap is one of 25 prioritized Capability Gaps (prioritized by OPNAV N-6/7 and the Marine Corps Combat Development Command) that are made up of Enabling Capabilities (ECs) and supporting products. The UAEO technology gap is being pursued as part of an overall effort that addresses the Sea Strike Capability Gap. This activity includes support to the Urban, Asymmetric Operations-related to Future Naval Capabilities (FNC) Enabling Capabilities for Improvised Explosive Devices, Modular Scalable Effects Weapons, Advanced Naval Fires Technology, Dynamic Target Engagement, Position Location Information and Hostile Fire Detection and Response.

FY 2005 Accomplishments:

- Continued development of tools and technologies to support Marine Corps ISR efforts Measurement and Signature Intelligence Tactical Remote Sensor System (MASINT/TRSS) in remote sensor integration within the Distributed Common Ground/Surface System (DCGS).
- Continued efforts to provide urban direction finding for Radio Frequency (RF) emitters from moving platforms.
- Continued development of improved fire control systems technologies to Expeditionary Fire Support System (EFSS) artillery and mortar systems.
- Continued design and development of advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability.
- Continued efforts to provide an obstacle detection system on the Expeditionary Fighting Vehicle (EFV) by conducting testing of a brassboard design.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2223 PROJECT TITLE: MARINE CORPS ATD

- Continued design, integration and demonstration of hostile fire detection and counter-fire system (GUNSLINGER).
- Continued development of innovative relay Beyond Line of Sight (BLOS) technology through integration and demonstration of secure mobile network/wireless local area network (LAN) communication technologies. Transition EFV high data rate secure wireless communication connection to acquisition program of record.
- Completed development and began transition of expeditionary maneuver warfare Ship to Objective Maneuver (STOM) planning and decision-making tools for Marine ground forces; provided prototype capability of Expeditionary Decision Support System (EDSS) to MARCORSYSCOM.
- Completed the development of multi-source Intelligence (INTEL) visualization algorithms to increase the efficiency and effectiveness of raw sensor data to actionable intelligence and commence testing/demonstration; provided six workstations to 3rd Radio Battalion for demonstration evaluation in Iraq Operation Iraqi Freedom (OIF). (FY 06 effort funded by PE 0603782N).
- Initiated development of improved lightweight computational fire control interface technology.

FY 2006 Plans:

- Continue efforts to provide urban direction finding of RF emitters from moving platforms.
- Continue development of tools and technologies to support Marine Corps ISR efforts (MASINT/TRSS) in remote sensor integration within the DCGS.
- Continue design and development of advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability.
- Continue development of improved lightweight computational fire control interface technology.
- Continue development of improved fire control systems technologies to EFSS artillery and mortar systems.
- Continue effort to incorporate advanced target acquisition target hand-off technologies to reduce sensor to shooter loop and improve target location. (Previous and concurrent effort funded by PE 0602131M)
- Continue investigation of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield. (Previous and concurrent funding provided by PE 0602131M)
- Continue integration of hostile fire detection and counter-fire system (GUNSLINGER).
- Continue development of innovative relay BLOS technology through integration and demonstration of secure wireless networks/secure wireless LAN communication technologies.
- Continue development and conduct open ocean testing of an obstacle detection system on the EFV.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2223 PROJECT TITLE: MARINE CORPS ATD

FY 2007 Plans:

- Continue development of tools and technologies to support Marine Corps ISR efforts (MASINT/TRSS) in remote sensor integration within the DCGS. Demonstrate a layered unattended sensor system.
- Continue development and demonstrate hostile fire detection and counter-fire system (GUNSLINGER). (Transitions to PE 0603114N.)
- Continue development of landmine countermeasure insensitive munitions technology. (Previously funded by PE 0602131M)
- Continue development of innovative relay BLOS technology through integration and demonstration of secure wireless networks/secure wireless LAN communication technologies. (Transitions to PE 0603235N.)
- Complete efforts to provide urban direction finding of RF emitters from moving platforms; provide algorithms to MARCORSYSCOM PM INTEL.
- Complete development and begin transition of an obstacle detection system on the EFV.
- Complete effort to incorporate advanced target acquisition target hand-off technologies to reduce sensor to shooter loop and improve target location; provide multiple software injectors to MARCORSYSCOM PM GC2. (Transitions to PE 0603114N.)
- Complete investigation of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield; provide prototype packaging to MARCORSYSCOM PM AMMO. (Transitions to PE 0603114N.)
- Complete development and transition improved lightweight computational fire control interface (EFSS) technology; provide prototype to MARCORSYSCOM PM EFSS. (Transitions to PE 0603114N.)
- Complete development and transition advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability provide prototype mortar tube, bipod and baseplate to MARCORSYSCOM PM EFSS. (Transitions to PE 0603114N.)

	FY 2005	FY 2006	FY 2007
HUMAN PERFORMANCE, TRAINING & EDUCATION	3,178	2,681	3,642

This activity develops and demonstrates advanced training technology and technologies that enhance neural and cognitive aspects of human performance including tactical decision-making, modeling, simulation, range instrumentation, synthetic environment generation and training effectiveness evaluation. This activity's name will change in FY 2008 to "Human Performance, Training and Survivability" to better describe its program/projects and some projects will migrate from the Firepower activity during FY 2008.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2223 PROJECT TITLE: MARINE CORPS ATD

FY 2005 Accomplishments:

- Continued development and evaluation of low-cost, dynamic cognitive skills training tools (tactical decision simulations) that cut across every echelon for individual, groups, and groups of groups.
- Continued demonstration and evaluation of technologies available for prototype of a Rapid Portable Synthetic Environment Generation capability.
- Completed the development of RF tracking and video tracking fusion for enhanced situational awareness in a MOUT training environment.
- Completed demonstration and transition of a prototype of Video Flashlights capability for enhanced situational awareness in a MOUT training environment for the Marine Security Forces.
- Initiated integrating cognitive performance improvement (augmented cognition) technology using operationally relevant systems and scenarios, and demonstrate improved human cognition via multiple sensory modalities.
- Initiated the integration and evaluation of cognitive state detection technologies with instructor-based training scenario applications and demonstrate improved individual task performance.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Initiate the development of tools to capture metrics and lessons learned from a variety of simulation and training sources.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete development and transition of low-cost, dynamic cognitive skills training tools (tactical decision simulations) that cut across every echelon for individual, groups, and groups of groups.
- Initiate development of scenarios and prototype applications demonstrating improved team performance in stressful urban environments.
- Initiate development of Physical Performance Enhancement (PPE) and survivability technology prototypes.

	FY 2005	FY 2006	FY 2007
LOGISTICS	3,060	3,005	3,585

This activity supports Marine Corps Expeditionary Logistics which is the practical discipline and real world

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2223 PROJECT TITLE: MARINE CORPS ATD

application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. Expeditionary Logistics replaces mass with assured knowledge and speed, is equally capable ashore or afloat in austere environments, and is fully scalable to meet uncertain requirements. Expeditionary Logistics logically divides into five pillars: deployment support, force closure, sustainment, reconstitution/redeployment, and command and control. These pillars are thoroughly integrated and perpetually related in execution.

FY 2005 Accomplishments:

- Continued development of a computer simulation-based tool for evaluating power requirements and powering options for electronic equipment used by MEF's.
- Completed development of hybrid alternative power systems (metal oxide battery technology) to demonstrate performance improvement. Final report is under evaluation for incorporation into the Seabasing FNC.
- Initiated exploring the development of portable fuel cell technologies capable of providing power in the 100 Watt to 500 Watt power range.
- Initiated next phase of research into developing a lightweight expeditionary bridging capability through assessment of bridge design, manufacturing, construction, and material solutions to include composites, extrusion, and forming techniques.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete development of a computer simulation-based tool for evaluating power requirements and powering options for electronic equipment used by MEF's.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Initiate research into developing a replaceable electrode battery power source that consists of a metallic structure that is consumed during power generation and then easily replaced with a new metallic component that restores a full charge. (Realigned from PE 0602131M.)

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2223 PROJECT TITLE: MARINE CORPS ATD

	FY 2005	FY 2006	FY 2007
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, AND INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (C4ISR)	2,956	2,575	3,079

This activity integrates and demonstrates enhanced communications and situational awareness in warfighting environments and communication and situational awareness technologies for near term USMC operations. Beginning FY 2008, Intelligence, Surveillance and Reconnaissance (ISR) will become a separate activity leaving the focus of this effort in Command, Control, Communications, Computers (C4).

FY 2005 Accomplishments:

- Completed and transitioned to the Marine Corps Tactical Systems Support Activity, the Command and Control Technology testbed culminating in the migration of functionality in the systems integration environment for user prototyping, and requirements generation on prospective commercial and developmental software products.
- Initiated development and demonstration of low-cost compact satellite communications on-the-move capability.
- Initiated integration and demonstration of naval tactical warfighting applications and network connectivity.
- Initiated development and demonstration of urban communications capability.

FY 2006 Plans:

- Complete development and demonstration of low-cost compact satellite communications on-the-move capability.
- Complete integration and demonstration of naval tactical warfighting applications and network connectivity.
- Complete development and demonstration of urban communications capability.
- Initiate demonstration of advanced network mobility and network security capabilities.
- Initiate and complete demonstration of urban navigation capability.

FY 2007 Plans:

- Complete demonstration of advanced network mobility and network security capabilities.
- Initiate integration and demonstration of broadband, conformal, ultra-high frequency/very high frequency (UHF/VHF) antennas to be completed in FY 2008.
- Initiate development and demonstration of measurement and signature intelligence data management and integration capability to be completed FY 2008.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2223 PROJECT TITLE: MARINE CORPS ATD

	FY 2005	FY 2006	FY 2007
FIREPOWER	2,699	2,335	3,285

This activity develops technology for application on current and future expeditionary weapons and elements of the kill chain. It includes, but is not limited to, the following technologies: fuze, fire control, launch/propulsion, lethality, and accuracy.

FY 2005 Accomplishments:

- Completed M1A1 Firepower Enhancement Program support from PE 0602131M. Technical results from this effort are under consideration for use on the M1A1 Main Battle Tank Product Improvement Program.
- Initiated and completed long range, non-lethal weapon, electronic projectile advanced development.
- Initiated variable effects conventional warhead concept development for experiments and tests to prove technological feasibility, assess operability, scalability and demonstrate general military utility and/or cost reduction potential.

FY 2006 Plans:

- Continue variable effects conventional munitions development.
- Initiate shipboard submunition Microelectromechanical System (MEMS) fuze safety and reliability enhancement effort from PE 0602131M. Prototype and demonstrate MEMS safe and arm device subsystems. Explore systems safety, shipboard storage, sensitivity, affordability and munitions effectiveness for expeditionary maneuver warfare and demonstrate general military utility and/or cost reduction potential.
- Initiate Marine Advanced Combat Headborne System Initiative (MACHSI) advanced technology development. Transitioned from FY 2005 PE 0602131M. The goal is to increase warfighter head and neck protection while enhancing warfighter comfort and minimizing warfighter encumbrance.

FY 2007 Plans:

- Continue all efforts of FY 2006.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2223 PROJECT TITLE: MARINE CORPS ATD

C. OTHER PROGRAM FUNDING SUMMARY:

ALL: NAVY RELATED RDT&E:
PE 0601152N (In-House Laboratory Independent Research)
PE 0601153N (Defense Research Sciences)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0603236N (Warfighter Sustainment Advanced Technology)
PE 0603612M (USMC Mine Countermeasures Systems - Adv Dev)
PE 0603635M (Marine Corps Ground Combat/Support Systems)
PE 0204163N (Fleet Telecommunications - (Tactical))
PE 0206313M (Marine Corps Communications Systems)
PE 0206623M (Marine Corps Ground Combat/Supporting Arms Systems)
PE 0305204N (Tactical Unmanned Air Vehicles (JMIP))

NON-NAVY RELATED RDT&E:
PE 0603004A (Weapons and Munitions Advanced Technology)
PE 0603005A (Combat Vehicle and Automotive Advanced Technology)
PE 0603606A (Landmine Warfare and Barrier Advanced Technology)
PE 0603607A (Joint Service Small Arms Program)
PE 0603619A (Landmine Warfare and Barrier - Adv Dev)
PE 0603772A (Advanced Tactical Computer Science and Sensor Technology)
PE 0604710A (Night Vision Systems - SSD)
PE 0604808A (Landmine Warfare/Barrier - SSD)
PE 0602301E (Computing Systems and Communications Technology)
PE 0602702E (Tactical Technology)

D. ACQUISITION STRATEGY:
Not Applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2297 PROJECT TITLE: CMC WARFIGHTING LAB CORE

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2297 CMC WARFIGHTING LAB CORE	50,520	35,059	35,082	37,604	33,439	34,174	34,952

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Marine Corps Warfighting Laboratory (MCWL) collects lessons learned from current operations, explores emerging threats and opportunities, and explores Joint and emerging service concepts through concept-based experimentation in order to enhance current and future warfighting capabilities. The use of modeling and simulation (M&S), both conducted within Service wargaming and virtual experiment venues (conducted in partnership with the Navy and Joint Forces Command (JFCOM)), will provide both a necessary Joint context for the Marine Corps Expeditionary Force Development System process as well as the opportunity to explore the implications of proposed future programs on seabased power projection capabilities.

“Live experimentation” permits exploration of prototype and surrogate technologies, as well as tactics, techniques, and procedures (TTPs), in order to better refine equipment requirements and to identify Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) initiatives needed to produce future capabilities. Experimentation encompasses inquiries into multiple warfighting areas, including: Command, Control, Communications, and Computers (C4); Intelligence, Surveillance, and Reconnaissance (ISR); Fires, Targeting, and Maneuver; Combat Service Support (CSS) and Force Protection; and Warfighting Excellence.

Using operational forces, MCWL conducts Advanced Warfighting Experiments (AWEs) supported by Limited Objective Experiments (LOEs), Limited Technical Assessments (LTAs), Wargames, and Studies. AWEs, LOEs, and LTAs examine discrete variables in as much isolation as can be achieved. Technologies assessed in LTAs are incorporated in LOEs while LOEs are building blocks from which resulting AWE-level campaigns are constructed. These campaigns (e.g., the Sea Viking experimentation series) are executed under the guidance of the Commandant of the Marine Corps (CMC) and in support of the Marine Corps Expeditionary Maneuver Warfare Enabling Capability List (ECL).

MCWL’s Sea Viking campaign is designed to transform the STOM concept into an operational reality coupled with implementing the emerging Distributed Operations (DO) concept. DO is a concept characterized as the physical

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2297 PROJECT TITLE: CMC WARFIGHTING LAB CORE

dispersion of network-enabled units, from squad to battalion size, over an extended battlespace.

- Sea Viking 2004 (SV04): (FY 2002 through calendar year (CY) 2004) SV04 was a series of related events that constituted the overall Marine Corps Service Experimentation campaign through 2004. Its goals and objectives were based on guidance from the CMC focusing on the seabased Marine Expeditionary Brigade (MEB), emphasizing execution of the Operational Maneuver from the Sea (OMFTS) and STOM concepts, in a Joint context. SV04 was significantly redefined in order to accommodate force deployments in support of OIF with experimental objectives refocused on operational assessment by forward-deployed forces operating in highly dispersed units.

- Sea Viking 2006 (SV06): (FY 2005 through FY 2006) SV06 builds on the results, findings, and events of SV04 in order to further develop a true seabased capability within the context of emerging Joint concepts. As with SV04 it uses an integrated “campaign” approach and is a key component of the Navy’s Sea Trial process. SV06 fully supports the Naval Transformation Roadmap. SV06 constitutes the principal exploratory effort into development of the future capabilities required for realization of the Naval Operational and Enhanced Network Seabasing concepts. In exploring the seabase, such issues as seabased fires are an integral part of Joint fires in support of the expeditionary force conducting operational maneuvers. Live experimentation, both in simulated war zone and actual theater (i.e., Iraq) environments, permits both explorations of prototype and surrogate technologies in order to better refine equipment requirements and to identify DOTMLPF initiatives needed to produce future capabilities. Live experimentation will provide a venue for practical development, testing, and refinement of alternative TTPs.

- Sea Viking 2008 (SV08): (FY 2007 through FY 2008) SV08 continues exploration of seabased forcible entry onto the irregular, nonlinear, battlespace emphasizing enhanced individual and small unit capabilities. While previous experiments in the Sea Viking series have focused on battalion-level “train, man, and equip” issues, SV08 strives to identify and assess technologies and procedures that will improve the individual Marine cognitively, physiologically, and through advanced simulation-based training. These could run the gamut from “simple” issues such as reducing the Marine’s combat load while increasing the level of force protection, to development of simulation systems that enable the Corps to produce the numbers of ground terminal air controllers MCWL’s SV06 DO experiments identified as an operational requirement. In keeping with the SV06 and DO objective of empowering small unit leaders, SV08 seeks to identify tools that will increase the individual Marine’s range of lethality (day and night), the situational awareness, and, ultimately, the ability to fight and win the Global War on Terrorism (GWOT).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2297 PROJECT TITLE: CMC WARFIGHTING LAB CORE

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS (C4)	7,756	8,121	7,291

This activity encompasses all MCWL C4 related experimentation efforts. Please note, although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact.

FY 2005 Accomplishments:

- Continued C4 support for the SV06 experimentation campaign.
- Continued OTH and OTM/COC dismounted communications investigations in support of I MEF and II MEF OIF deployments. These efforts centered on the overarching Expeditionary Tactical Communication System (ETCS) efforts coupled with OTM/COC investigations.
- Completed C4 support for the SV04 experimentation campaign.
- Initiated small unit DO efforts, as they relate to command and control (C2) functions.

FY 2006 Plans:

- Continue all efforts of FY 2005, less those noted as completed above.
- Complete C4 support for the SV06 experimentation campaign.
- Complete experimentation of initial SV06 OTH dismounted communications concept demonstrator.
- Complete experimentation of SV06 OTM/COC for vertical maneuver element (VME).
- Complete small unit enhancement efforts based on the results of initial DO C2 experimentation.
- Initiate C4 support for the SV08 experimentation campaign.
- Initiate experimentation of enhanced OTH dismounted communications concept demonstrator for SV08.

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as completed above.
- Initiate exploration of the battalion COC requirements for surface maneuver elements (e.g., for EFV and LAV platforms).
- Initiate experimentation of concept demonstrators to support company and below alternative C2 architectures.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2297 PROJECT TITLE: CMC WARFIGHTING LAB CORE

- Initiate C4 related small unit enhancements against irregular forces, including urban terrain.

	FY 2005	FY 2006	FY 2007
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR)	18,609	7,215	6,598

This activity includes MCWL ISR related experimentation efforts involving enhanced reconnaissance; sensors (to include mine detection); and unmanned ground and aerial vehicles. Please note, although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact.

The increase in FY 2005 was due to GWOT support for Counter IED efforts.

FY 2005 Accomplishments:

- Continued ISR support for the SV06 experimentation campaign.
- Continued Visual Intelligence, Surveillance, Tactical Alert System (VISTAS) (formerly known as Local Area Sensor System (LASS)) experimentation. VISTAS is an unattended ground sensor system.
- Continued efforts to support enhanced ISR capabilities to better enable Marine infantry units to locate enemy forces as part of DO experimentation.
- Completed ISR support for the SV04 experimentation campaign.
- Completed Dragon Eye Unmanned Aerial Vehicle (UAV) payload development, integration, experimentation, and refinement of Tactics, Techniques, and Procedures (TTPs). Dragon Eye is a back-packable system, with modular payloads, designed to provide the small unit leader with an "over-the-hill" reconnaissance and surveillance capability.
- Completed DR Mobile Ground Sensor (MGS) efforts and transition to Joint Program Office. DR is a ground mobile sensor (Unmanned Ground Vehicle (UGV)) that will be used by Marine infantry battalions.
- Completed development of the Ion Mobility Spectrometer Explosive Detection System (IMSEDS). IMSEDS has a limited range and has proved operationally unsuitable. Therefore, initiated and completed Venom prototype experimentation. Venom is a tube-launched system allowing convoy stand-off protection by engaging/detonating possible vehicle-borne IEDs. Efforts support OIF.
- Initiated and Completed the assessment of the Marine Corps Transparent Ballistic Gunners Shield (MCTAGS). MCTAGS will provide a reasonable level of 360 degree armor protection for combat wheeled vehicles. Efforts support OIF.
- Initiated and completed Beam Hit Digital Down Link (DDL) capability. The Beam Hit program (a collaborative

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2297 PROJECT TITLE: CMC WARFIGHTING LAB CORE

effort) facilitates development of an IED change detection system. Efforts support OIF.
- Initiated assessment of alternative change detection concept demonstrators. Efforts support OIF.
- Initiated experimentation of Tier II UAV concept demonstrators to provide persistent ISR at the Regimental level.
- Initiated additional IED investigations into promising detect and neutralize technologies.
- Initiated and completed MCM analysis of alternatives.
- Initiated and complete experimentation with the Hyper Detection Locating System (HDILS). HDILS technology provides the capability to detect surface, and subsurface, IEDs and differentiate mass composition, e.g., amongst metal, wood and plastic. Effort focuses on detection at increased speed and at enhanced distances. Efforts support OIF.

FY 2006 Plans:

- Continue all efforts of FY 2005, less those noted as completed above.
- Complete ISR support for the SV06 experimentation campaign.
- Complete VISTAS experimentation and transition to Joint Program Office.
- Complete efforts to enhance the reconnaissance and surveillance capabilities to better enable Marine infantry units to locate enemy forces as part of DO experimentation.
- Initiate ISR support for the SV08 experimentation campaign.

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as completed above.
- Initiate efforts to develop the TTPs required for small infantry units to employ UGVs, UAVs, and unattended ground sensors.
- Initiate ISR related small unit enhancements against irregular forces, including urban terrain.
- Initiate participation in DARPA’s development and upgrade of the WASP micro UAV and conduct extended operational assessment of WASP Block I through Block III.
- Initiate investigations into Multi-Sensor Surveillance System (MSSS) efforts. MSSS calls for an advanced and robust surveillance system for wide area base perimeter surveillance.

	FY 2005	FY 2006	FY 2007
FIRES, TARGETING, AND MANEUVER	8,702	5,042	4,409

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2297 PROJECT TITLE: CMC WARFIGHTING LAB CORE

This activity includes MCWL experimentation efforts in the areas of fires, targeting, and maneuverability. Please note, although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact.

FY 2005 Accomplishments:

- Continued fires, targeting, and maneuver support for the SV06 experimentation campaign.
- Continued evaluation of vehicles as surrogates for Internal Transportable Vehicles (ITVs).
- Completed fires, targeting, and maneuver support for the SV04 experimentation campaign.
- Completed first Dragon Fire II concept demonstrator. This includes the gun assembly, safety release testing/documentation, ammunition purchase, and initial firing tests. This effort is an augmentation to the Mobile Fire Support System (MFSS) Congressional enhancement (Project C9154).
- Completed counter shooter efforts by testing alternative systems. Efforts supported OIF.
- Initiated Dragon Fire II next generation concept demonstrator using the Dragon Fire/LAV test-bed.
- Initiated and completed investigations into highly mobile, internally transportable counter-fire radar to support a VME.
- Initiated HMGI. HMGI is a collaborative effort, to include related design, fabrication, and testing of prototype advanced mounts.
- Initiated investigations into the ECASS which is a system that has the capability to adjust itself continuously to changing road conditions. This was a collaborative effort.
- Initiated and completed Coalition Combat Identification (CCID) efforts. This collaborative effort supported integration of Battlefield Target Identification Devices (equipment) on United States Marine Corps (USMC) M1A1 main battle tanks.

FY 2006 Plans:

- Continue all efforts of FY 2005, less those noted as completed above.
- Complete fires, targeting, and maneuver support for the SV06 experimentation campaign.
- Complete evaluation of vehicles as surrogates for ITVs.
- Complete first Dragon Fire II concept demonstrator firing tests.
- Initiate fires, targeting, and maneuver support for the SV08 experimentation campaign.
- Initiate and complete integration of Dragon Fire II with radar for a quick counter fire capability.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2297 PROJECT TITLE: CMC WARFIGHTING LAB CORE

- Initiate integration of Remote Operations Video Enhanced Receiver (ROVER) video imaging capability with Strike-Link FAC/FO digital CAS Suite.
- Initiate assessment of alternatives of man portable standoff breaching capabilities.
- Initiate and complete assessment of 120-millimeter (mm) mortar rounds with scalable effects.
- Initiate assessment of alternatives and experimentation of land mine breaching and neutralization technologies.

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as completed above.
- Complete development and assessment of advanced common mount for HMGI.
- Complete ECASS investigations/experimentation.
- Complete ROVER integration with Strike-Link FO/FAC digital CAS Suite.
- Complete analysis of alternative man portable standoff breaching capabilities.
- Initiate Fires, Targeting, and Maneuver related small unit enhancements against irregular forces, including urban terrain.

	FY 2005	FY 2006	FY 2007
COMBAT SERVICE SUPPORT (CSS) AND FORCE PROTECTION	5,085	3,788	3,747

This activity includes MCWL experimentation efforts involving seabasing, logistics, CSS, urban combat, medical, force protection, as well as training and education. Please note, although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact.

FY 2005 Accomplishments:

- Continued CSS and force protection support for the SV06 experimentation campaign.
- Continued to investigate individual equipment to enhance Marines' survivability and combat effectiveness. This effort included protective face/neck masks/shields, lower torso gear, whole body covering blankets that not only supported MCWL experimentation, but OIF as well.
- Continued High Speed Connector (HSC). HSC is a commercially available advanced hull and propulsion technology. The HSC program develops, integrates, and experiments with Marine unique Tactics, Techniques, Technologies, and Procedures (TTTPs).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2297 PROJECT TITLE: CMC WARFIGHTING LAB CORE

- Continued bio-science (medical) initiatives, to include Tactical Medical Coordination System (TacMedCS), a prototype system to enhance Casualty Evacuation (CASEVAC) tracking; Combat Trauma Registry (CTR), the raw data collection, entering of pertinent data into the CTR, performing analysis, and reporting on casualties treated during OEF as well as OIF; evaluating Dragon Doc/Medical Assault Packs (MAP), upgraded Field Corpsman treatment items; and providing for Mini Forward Resuscitative Surgery System (FRSS) capability study using a proven method to provide medical support for STOM/DO.
- Completed Dust Palliative efforts by experimenting with a suitable low-maintenance, lightweight, replacement and/or augmentation to current AM-2 matting to facilitate the construction or enhancement of Forward Operating Bases (FOBs). This effort supported MCWL sponsored experimentation, as well as OIF.
- Completed CSS and force protection support for the SV04 experimentation campaign.
- Initiated and completed support for NIRF prototype. NIRF (a collaborative effort) is a Quick-Reaction Capability (QRC) intended to provide a countermeasure against IEDs. Program directly supports OIF.

FY 2006 Plans:

- Continue all efforts of FY 2005, less those noted as completed above.
- Complete CSS and force protection planning support for the SV06 experimentation campaign.
- Initiate CSS and force protection support for the SV08 experimentation campaign.
- Initiate experimentation of simulation-based training technologies to enhance small unit leader decision-making ability.
- Initiate Vehicle Hardening assessments/experimentation efforts.
- Initiate IED Detector Dog experiment that will merge specialized breeding, urban conditioning and multi-disciplinary training techniques in support of small unit infantry operations

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as completed above.
- Complete and transition HSC experimentation efforts to Joint Program Office.
- Complete experimentation of simulation based training technologies to enhance small unit leader decision-making ability.
- Initiate Joint Aero-ballistic Non-lethal Incapacitation System (JANIS) investigations. JANIS encompasses the development of an untethered electro-muscular incapacitation system with a range of zero (0) to one hundred (100) meters.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2297 PROJECT TITLE: CMC WARFIGHTING LAB CORE

	FY 2005	FY 2006	FY 2007
MARINE CORPS WARFIGHTING LABORATORY (MCWL)OPERATIONS (SUPPORT)	5,254	6,864	8,229

MCWL Operations (Support) efforts include overall MCWL experimentation doctrine, planning, analysis, data collection, as well as technology transition tracking efforts. Please note, although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact.

FY 2005 Accomplishments:

- Continued support for the SV06 experimentation campaign.
- Continued to synthesize results and lessons learned into proposed DOTMLPF recommendations for the Marine Corps.
- Continued to provide technical, strategic, and managerial support to Marine Corps experimentation.
- Continued to provide overall analysis and reporting of experimentation efforts, analytical assistance during experiment design, and maintenance of an ad-hoc analysis capability.
- Completed support for the SV04 experimentation campaign.

FY 2006 Plans:

- Continue all efforts of FY 2005, less those noted as completed above.
- Complete support for the SV06 experimentation campaign.
- Initiate support for the SV08 experimentation campaign.
- Initiate and complete Integrated Global Positioning System Radio System (IGRS) II data collection/reconstruction efforts.

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as completed above.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2297 PROJECT TITLE: CMC WARFIGHTING LAB CORE

	FY 2005	FY 2006	FY 2007
WARFIGHTING EXCELLENCE	5,114	4,029	4,808

This activity includes MCWL experimentation efforts in the areas of wargaming, the Center for Emerging Threats and Opportunities (CETO), and Joint experimentation. Please note, although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact.

FY 2005 Accomplishments:

- Continued support for the SV06 experimentation campaign.
- Continued Executive Agent (EA) responsibilities for Joint Title Ten (X) / Joint Concept Development and Experimentation (JCDE) programs such as Unified Quest, Unified Course, and Unified Engagement. Title X wargames generally address future capabilities in the context of core Title X readiness responsibilities. JCDE efforts include the co-sponsored Marine Corps/JFCOM Joint Urban Warrior (JUW) program designed to support JFCOM Joint Urban Operations (JUO) efforts. JUW is focused on the integration of the full spectrum of advanced operational concepts, organizational innovations, technologies, and other transformational opportunities in complex urban operations.
- Continued the management and oversight of non Title X Wargaming to include the highly visible Office of the Secretary of Defense’s (OSD’s) Net Assessment Transformation War Game series and the SOCOM wargaming series.
- Continued to conduct quarterly Emerald Express seminars, resulting in the collection and dissemination of insights and observations from Operating Forces. Produced reports for the purpose of Professional Military Education (PME) and to further advance the lessons learned process.
- Continued to provide CETO support. CETO’s mission is to: 1) prevent operational and tactical surprises to senior warfighting commanders by assessing the future security environment in light of emerging threats and potential conceptual and technological opportunities, 2) help focus science and technology and experimental efforts by appraising promising concepts and technologies; and 3) serve as a catalyst to stimulate thought and debate on issues of importance to the USMC.
- Completed support for the SV04 experimentation campaign.
- Completed Joint Experimentation Cell efforts by conducting Joint Warfighting Capability Assessments (JWCAs) and participating on Functional Capability Boards (FCB), as well as providing Joint Integration and Implementation Planner support to the Marine Corps.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 2297 PROJECT TITLE: CMC WARFIGHTING LAB CORE

FY 2006 Plans:

- Continue all efforts of FY 2005, less those noted as completed above.
- Complete support for the SV06 experimentation campaign.
- Initiate support for the SV08 experimentation campaign.
- Initiate the Joint Force Protection (JFP) ACTD to provide warfighters with a simple, timely, comprehensive understanding of deployment and distribution information. ACTDs are intended to rapidly field needed Joint capabilities by employing emergent mature technologies matched with innovative operational concepts.

FY 2007 Plans:

- Continue all efforts of FY 2006, less those noted as completed above.
- Initiate investigations/participation into promising ACTDs.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E: The Navy’s 6.1 program contributes indirectly to this effort.
PE 0602131M (Marine Corps Landing Force Technology)

D. ACQUISITION STRATEGY:
Not Applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ADVANCED DEPLOYABLE WATER PURIFICATION TECHNOLOGY	0	1,300

This effort supports advanced deployable water purification technology research.

	FY 2005	FY 2006
ADVANCED MINE DETECTION	2,507	0

Continued development of a hand-held, portable Advanced Mine Detector (AMD) system for the U.S. Marine Corps. Once developed, the detector will enable Marines to accurately detect buried metallic and non-metallic anti-tank and antipersonnel mines and unexploded ordnance with far fewer false alarms than is possible with current detection systems. Quadrupole Resonance (QR) technology is ideally suited for discriminating buried landmines from clutter (i.e., metal objects, rocks, etc.) because QR sensors measure explosives at the molecular level. The sensors emit low-frequency, specially tuned radio waves and then measure the unique responses from specific explosives.

	FY 2005	FY 2006
ARMORED PATROL VEHICLE	0	1,500

This effort supports armored patrol vehicle research.

	FY 2005	FY 2006
C3RP	4,533	3,400

FY 2005 - This effort established an Interdisciplinary Center of Excellence in research relevant to national security and the Marine Corps on the Central Coast of California by bringing together Universities, government agencies (both federal and state), and the private sector, which can evolve into a valuable national resource. Continued efforts to explore this potential and to identify and support relevant research and expertise.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

FY 2006 - This effort supports C3RP research.

	FY 2005	FY 2006
COMMON REMOTELY OPERATED WEAPON SYSTEM (CROWS)	0	1,000

This effort supports the Common Remotely Operated Weapon System(CROWS).

	FY 2005	FY 2006
CRAFT INTEGRATED ELECTRONIC SUITE (CIES)	964	1,000

FY 2005 - Integrated an electronic control system and added the sensors and C2 systems required to enhance the situational awareness of the crew of a small boat (Stilitto). The objective of the work is to ready the Stilitto for participation in experimentation that is aimed at understanding ad hoc survivable networks. The deliverable is a boat with upgraded electronic control and C4ISR. Technology transfer to the Sea Lion program of record is expected.

FY 2006 - This effort supports CIES research.

	FY 2005	FY 2006
EXCALIBUR UNMANNED COMBAT AERIAL VEHICLE	967	0

Developed a concept of operations for the Excalibur tactical unmanned combat air vehicle demonstrator. The Excalibur is anticipated to be a survivable, Vertical Takeoff and Landing (VTOL), tactical-class unmanned combat air vehicle that can reach conflict areas in a timely manner, engage and destroy targets of opportunity, provide overhead coverage at trouble spots, such as roadside ambushes, and operate without runways or launch mechanisms.

	FY 2005	FY 2006
EXPEDITIONARY UNIT WATER PURIFICATION II	11,089	8,700

FY 2005 - Conducted comprehensive search for robust, dynamic, other than classical S&T approaches to water desalination, reclamation, energetics, distribution, on the national and international scale. Funded select

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

S&T efforts deemed to have higher than average expectation of reducing the cost of water purification in terms of power, footprint, and so on. Utilizing both the Generation I demonstrator, and the Generation II preliminary specification and engineering design, conducted studies and analysis of promising S&T derived from the Expeditionary Warfare Water Purification (EUWP) S&T program to date. Simultaneously, developed a Generation II, 300 – 500,000 gallon per day (GPD) engineering prototype which can be used to develop knowledge products for military, federal, and applicable commercial entities of successful S&T also emanating from the EUWP S&T investment program, as well as newly emerging technology from independent sources. Such studies and analysis process will be available for use to address such issues as scalability of select “technology insertion” candidates into large capacity water systems both ship board and land based.

FY 2006 - This effort supports expeditionary unit water purification II research.

	FY 2005	FY 2006
LASER INTEGRATED TARGET ENGAGEMENT SYSTEM	0	3,600

This effort supports laser integrated target engagement system research.

	FY 2005	FY 2006
MAN-PORTABLE QUADRUPOLE RESONANCE LANDMINE DETECTION	0	2,600

This effort focused on advanced development and demonstration of landmine countermeasures technologies; specifically, a landmine detection system on quadrupole resonance technology, engineered into a man-portable configuration.

	FY 2005	FY 2006
MARITIME AIR-GROUND TASK FORCE SITUATIONAL AWARENESS	0	1,000

This effort supports maritime air-ground task force situational awareness research.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
MOBILE FIRE SUPPORT SYSTEM - DRAGON FIRE II	988	2,800

FY 2005 - Funding/efforts were augmented by Marine Corps Warfighting Laboratory (MCWL) core funding; discussed in Project C2297 under Fires, Targeting, and Maneuver subsection.

The Mobile Fire Support System (MFSS), now referred to as Dragon Fire II, is an automated and modular rifled 120-millimeter fire support system concept demonstrator that uses automation to improve precision, responsiveness, and digital connectivity to support units. It is capable of firing from its towed carriage and from its modified Light Armored Vehicle (LAV) interchangeably and in its towed configuration is transportable within the MV-22 Osprey aircraft.

FY 2005 Accomplishments: Completed software and engineering design. Fabricated the new concept demonstrator system and test firings were conducted to complete the system.

FY 2006 - This effort supports the Mobile Fire Support System-Dragon Fire II.

	FY 2005	FY 2006
PORTABLE METHANOL FUEL CELL	964	0

Effort was designed to develop direct methanol fuel cell electrochemistry by employing advanced micro-fuel cell technology in passive, ambient conditions (e.g. no balance of plant for humidity and no temperature controls). This no fault methanol fuel cell module (cells will be both in parallel and in series) will leverage industrial battery research efforts directed towards the consumer market. The ultimate research goal is to provide a lighter, longer lasting power supply thereby reducing the weight of batteries carried by individual Marines.

	FY 2005	FY 2006
PRECISION APPROACH AND LANDING SYSTEM (PALS)	0	2,700

This effort supports research of the Precision Approach and Landing System(PALS).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
PROJECT ALBERT	3,292	0

Under the umbrella of MCWL experimentation efforts, Project Albert provides design and development of new tools to capture emergent behavior in synthetic environments that, over time, will lead to more effective warfighters. The project's vision includes strong interdisciplinary collaborative teams to address previously unanswered questions relevant to success in warfare. The goal of Project Albert is to investigate and apply promising technologies to support military decision-makers in meaningful ways through modeling, analysis, and new ways of combining them to include important phenomena inadequately represented by current techniques.

FY 2005 Accomplishments:
- Continued modeling and developing Data Farming techniques. Specific areas of application included Maneuver in Urban Operations and UAV for concurrent operations.
- Initiated Convoy Protection, Improvised Explosive Devices, Manpower versus Technical Tradeoff in Combat Support Operations, Search Pattern Effectiveness for UAVs in a Maritime Environment, and Modeling Aspects of Net Centric Operations.

	FY 2005	FY 2006
RAPID DEPLOYMENT FORTIFICATION WALL (RDFW)	967	0

RDFW prototyped development/experimentation effort being pursued by MCWL mainly via Congressional enhancements. The purpose of this Improved Expedient Fortification Construction program is to experiment with commercial-off-the-shelf expedient fortification construction systems. By leveraging modern materials and techniques, the Marine Corps can increase force protection while decreasing the manpower hours needed to construct expedient fortifications.

FY 2005 Accomplishments:
- Conducted extensive ballistic testing using the Air Force's Force Protection Battle Lab.
- Purchased additional grids, in support of the Second Marine Expeditionary Force (II MEF)/OIF deployments, for force protection and road stabilization in theater experimentation in Iraq.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
STUDY TO IDENTIFY AND EVALUATE ALTERNATIVE FIXED-WING LIFT PLATFORMS	967	0

Identified and evaluated alternative vertical lift platforms in the event of Joint Strike Fighter (JSF) Short Takeoff Vertical Landing (STOVL) cancellation. Recent design reviews of the STOVL variant of JSF project it to be overweight for the System Design & Development (SDD) Phase, which could cause it to fall short of several key performance parameters. This study performed an Analysis of Alternatives (AOA) in the event of cancellation of the current design effort.

	FY 2005	FY 2006
TELEPRESENT RAPID AIMING PLATFORM (TRAP)	977	3,000

FY 2005 - The Remote Precision Gun (also known as TRAP) is a remotely operated weapon system which integrates 5.56 to .50 caliber systems with man-in-the-loop remotely controlled robotic firing and observation systems.

FY 2005 Accomplishments:
- Continued the design overhaul and upgrades initiated in FY 2004.
- Integrated laser range finding module and improved optics with digitally generated aiming crosshair into the system.
- Conducted operational assessment of the upgraded system with II MEF in theater. Efforts support OIF.
- Published report to MCCDC for potential transition to acquisition program of record.

FY 2006 - This effort supports TRAP research.

	FY 2005	FY 2006
TRANSPORTABLE TRANSPONDER LANDING SYSTEM	1,943	0

TTLS was originally developed under a DARPA effort through Naval Air Systems Command (NAVAIR) and Advanced Navigation and Positioning Corporation (ANPC). The system was designed to provide a precision approach capability by using inexpensive ground systems to provide position information for aircraft equipped with a transponder and standard Federal Aviation Administration (FAA) Category I Instrument Landing System (ILS) equipment. In order for TTLS to suit the USMC tactical mission requirements, several technologies must be

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

developed. These include: Link 4A data-link guidance output to support USMC aircraft; multiple aircraft tracking and guidance; miniaturization of the system for mounting on a supporting ground vehicle; reciprocal approaches/runway support; Local Sector Surveillance and Control; and reduced TTLS susceptibility to jamming.

FY 2005 Accomplishments:
- Continued development efforts in support of the TTLS concept demonstration.
- Tested a new interrogation method that doubles the current surveillance range while minimizing aircraft transponder occupancy to address the FAA’s concerns.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603651M
PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	5,809	2,358	1,405	10,865	10,879	11,097	11,320
3022 JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT	5,809	2,358	1,405	10,865	10,879	11,097	11,320

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program funds the research and development of next-generation Non-Lethal Weapons (NLWs) and includes performing analysis, technical development efforts, and modeling and simulation necessary to ensure optimum weaponizing and use of these NLWs. Next-generation NLW systems focus on long-range localized Non-Lethal (NL) effects to identified threat individuals (or groups of individuals) and/or their threat weapons systems operating in complicated environments such as urban areas, crowds, buildings, vehicles, boats and also in close proximity to high-value civilian establishments. This program transitioned from Program Element (PE) 0603114N, Power Projection Advanced Technology by order of the Under Secretary of Defense for Acquisition, Technology, and Logistics, USD(AT&L)to establish a separate PE for Joint Non-Lethal Weapons Technology Development and to establish the Marine Corps as the executive agent for DoD Joint Non-Lethal Weapons RDT&E.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603651M
PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	5,809	2,394	1,397
Congressional Undistributed Reductions/Rescissions	0	-36	0
Rate Adjustments	0	0	8
FY 2007 President's Budget Submission	5,809	2,358	1,405

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The primary objective of this Program Element is the development of technologies that lead to the next-generation of Non-Lethal Weapons. The program consists of a collection of projects that range from studies and analyses to the development and evaluation of feasibility demonstration models. Individual project metrics reflect the technical goals of each specific project. Typical metrics include both the effectiveness of the technology, human effects and effectiveness, and potential for compliance with policy and legislation. Overarching considerations include the advancement of related Technology Readiness Levels and Human Effects Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603651M PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT
PROJECT NUMBER: 3022 PROJECT TITLE: JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
3022 JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT	5,809	2,358	1,405	10,865	10,879	11,097	11,320

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project funds the research and development of next-generation NLWs and includes performing analysis, technical development efforts, and modeling and simulation necessary to ensure optimum weaponizing and use of these NLWs. Next-generation NLW systems focus on long-range localized NL effects to identified threat individuals (or groups of individuals) and/or their threat weapons systems operating in complicated environments such as urban areas, crowds, buildings, vehicles, boats and also in close proximity to high-value civilian establishments.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
JOINT NON-LETHAL WEAPONS	5,809	2,358	1,405

FY 2005 Accomplishments:

- Initiated effort to conduct feasibility assessments and demonstrations of promising non-lethal technologies and system concepts. Initial efforts will assess the general utility, effect, and effectiveness of technologies for incapacitating personnel, clearing facilities, stopping vehicles and vessels, and denying enemy access to protected areas.
- Initiated design of a man-transportable laser weapons system that can be used for non-lethal counter-personnel or non-lethal counter-material applications through ultra-high precision engagement of selected targets with minimal collateral damage.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603651M PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT
PROJECT NUMBER: 3022 PROJECT TITLE: JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Initiate research to define the optimum approaches, technologies and tactics necessary to clear a facility/building with and without entry. The goal is to develop the next generation clear-a-space device or system that can effectively incapacitate or force evacuation of a facility with minimal collateral effects or injury to occupants and delivered to the target(s) at range.
- Initiate investigation of technology suitable for long-range, non-lethal vehicle or vessel stopping with reversible effects, and minimal collateral effects. The technology will be suitable for applications in complex operational environments such as within crowds, within urban environments, within buildings and vehicles, for non-lethal precision strike (extended duration incapacitation/treat neutralization), and for joint force protection applications.
- Initiate fabrication of a man-transportable laser weapons system.

FY 2007 Plans:

- Continue all efforts of FY 2006.
- Initiate research to develop an understanding of the complex relationships between individual, group and crowd dynamics to understand the macro effects of NLWs. Specifically, investigate factors that cause crowds to move to violent behavior, and what non-lethal technologies will be effective in controlling or mitigating violent crowd behavior.
- Initiate effort to examine and optimize non-lethal effects and effectiveness of various non-lethal stimuli, to include light, acoustics, electrical, high power laser, high power microwave and active denial technology. Research would include human effects analysis with respect to existing non-lethal stimuli and other emerging system stimuli to characterize behaviors and their operational relevance.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0602651M Joint Non-Lethal Weapons Applied Research
PE 0603851M Nonlethal Weapons

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	168,195	180,106	0	0	0	0	0
2497 JOINT EXPERIMENTATION VISUALIZATION	163,845	98,170	0	0	0	0	0
3145 JOINT COMBINED TRAINING CENTER (JCTC)	0	4,925	0	0	0	0	0
3149 JOINT TRAINING	0	23,221	0	0	0	0	0
3153 JOINT NATIONAL TRAINING CAPABILITY (JNTC)	0	46,190	0	0	0	0	0
9999 CONGRESSIONAL PLUS-UPS	4,350	7,600	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Combatant Commander (COCOM), U.S. Joint Forces Command (USJFCOM) was chartered “as the Executive Agent for conducting joint warfighting concept development and experimentation within the Department of Defense.” The Secretary of Defense signed USJFCOM’s Joint Warfighting Experimentation Charter on 15 May 1998. H8150, 22 September 1998, Sec 922, directed the establishment of Joint Warfighting Experimentation.

The globalization of technology and commerce, driven in part by the information revolution, is changing the nature and conduct of conflict by offering new means and capabilities to our adversaries. The continuing proliferation of ballistic missiles, cruise missiles, Weapons of Mass Destruction (WMD) and other technologies is providing even relatively small nations and organizations the ability to challenge the US directly and to threaten their neighbors and then attempt to deny access to US forces. Requirements associated with defense of the US are now different and there is a premium on the ability of US forces to respond more rapidly and

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM

decisively to emerging crises and conflicts. In an era of uncertainty, U.S. forces must be capabilities-based rather than threat-based.

The terrorist attacks on the US homeland in September 2001, and the US and allied response in Afghanistan and Iraq have underscored the new challenges that US forces will face in the coming decades in coping with the threat of terrorism and consequence of failed states. Coordinated Joint Concept Development and Experimentation (JCDE) effort is an indispensable tool to support transformational objectives and to improve US capabilities. These capabilities will ensure the nation’s ability to conduct a war on terrorism through the use of all instruments of power. This war cannot be won solely with legacy means. Development of advanced techniques, tools, and organizations to defeat terrorism and meet other new challenges of the 21st century requires new thinking and aggressive experimentation to develop alternatives and ensure the effectiveness of the future joint force.

The work of JCDE is imperative because emerging changes in the threat will not await the wholesale recapitalization of today’s force structure and because new equipment alone will not provide the capabilities needed for future forces.

COCOMs have input to the priorities for experimentation through USJFCOM's Combatant Commander Engagement program. The future of joint warfighting is the USJFCOM area of responsibility. Joint Experimentation’s purpose is to lay the foundation for national security transformation. Development of a coherent joint force starts with aggressive concept development and robust joint experimentation. USJFCOM establishes a common joint context for DOD which has already proven to be a powerful tool fostering coherence, improved stewardship and early interoperability materiel solutions that are “born joint.” Concept development, both Joint and Service, happens through intellectual exploration, focus, and partnerships.

DOD priorities supported by Joint Experimentation: a) Successfully pursue the Global War on Terrorism (GWOT); b) Strengthen joint warfighting capabilities; c) New concepts of global engagement; d) Transform the joint force; e) Homeland Security; f) Optimize intelligence capabilities; and g) Improve Department of Defense processes.

We ensure this transformation by exploring, testing, and then establishing new combinations of concepts, capabilities, people, and organizations. Through the process of discovering new capabilities, we can exploit our nation’s strengths and advantages while protecting ourselves from asymmetric forces that threaten our strategic superiority. Joint Experimentation implements this transformation mission through a process of

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM

discovery, innovation, concept development, and experimentation to provide for optimal joint future force capability.

The Joint Experimentation campaign focuses on developing two distinct products as the result of a two-path strategy on which we base our approach to innovation. The first path is called the Joint Prototype Pathway. This conceptual/prototypical system or doctrine evolves from concept experimentation in concert with our partners. These systems are inserted into real world situations (e.g., U.S. Forces Korea) so that we can expand the experimental ground and refine the concept/prototype at the user level to ensure the solutions work as envisioned. This path is designed to help the Department improve near-term warfighting capabilities now by taking new ideas or concepts that originate on the joint concept development pathway and converting them into physical form, as developmental prototypes. From there, these prototypes are put into the hands of joint warfighters as quickly as possible to validate the capability at the user level. While Commanders feel that a number of new concepts offer greater promise than current capabilities, they use them with the understanding that they are part of the continuing refinement process. Some aspects of these concepts were utilized in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF).

The second path is called the Joint Concept Development Pathway. This path and its products consist of actionable recommendations that result from collaborative experimentation with new concepts and capabilities that focus on the next decade. Based on how these concepts perform at the user level, we make recommendations to senior leaders that help them decide how to invest military resources in the next decade. Work performed on the joint concept development path is dedicated to making long-term improvements to military capability, focusing on making next decade improvements to joint warfighting. Part of the campaign strategy is continuous experimentation using Combatant Commanders' exercises and operations (engagement and combat) across a Distributed Continuous Experimentation Environment (DCEE). USJFCOM designed DCEE to be a world-class resource designed to support continuous experimentation; a sophisticated network of high-tech model and simulations with a global reach, both virtual and physical. This laboratory is capable of conducting various experiments, either locally or globally and, because of this, our partners, the Services, COCOMs, allied nations, or various agencies, may participate in experiments at levels specific to their needs and interests.

For joint concept experimentation to be effective, we use four common scenarios that reflect current and future threats based on the geopolitical and military realities we see emerging between now and 2015: 1) Major Combat operations against an inaccessible adversary who presents a global WMD threat; 2) Joint operations in urban environments; 3) Operations against a non-state actor with significant regional combat capability, weapons of mass effect, and ties to global terrorist operations; and 4) Operations against a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM

faltering or failing state that has regional WMD of mass effect capability. These scenarios are the basis for evaluating the major military challenges that were derived from strategic guidance and input from the Services and COCOMs. USJFCOM's efforts over the next several years will focus in particular on the following concepts: Achieving decision superiority: shared-situation understanding so that we can make decisions and take action faster than any adversary; Creating coherent effects: Harmonizing military, interagency, and multinational activities at the strategic, operational, and tactical levels against any type of adversary; Conducting and supporting distributed operations: Planning, preparing, and executing simultaneously in multiple theaters and widely distributed points of action within each theater while denying sanctuaries and protecting ourselves from Homeland to point of action.

The Management Initiative Decision (dated 12 Jan 2003) for Advanced Training Technology established the Joint National Training Capability (JNTC). The mission is to develop the capabilities that integrate live, virtual and constructive elements into a seamless joint training environment. JNTC creates joint warfighting conditions through a networked collection of interoperable training sites and nodes that synthesize personnel, doctrine and technology to achieve COCOM and service training requirements.

The Secretary of Defense Program Decision Memorandum (PDM) (dated 12 Dec 2003) tasked USJFCOM with the responsibility for maintaining Joint Simulation System (JSIMS) software and establishing a Software Support Facility (SSF) at the Joint Warfighting Center, pending the results of an Analysis of Alternatives (AoA). As a result of the AoA findings, the SSF will further develop additional enhancements to constructive simulations designed to eliminate COCOM training gaps. The center provides the joint training environment with the ability to insert emerging technology or reuse existing systems in the constructive training architecture.

PDM II of 22 December 2004 signed by the Deputy Secretary of Defense conveyed the budget decision to support Training Capability Analysis of Alternatives Joint National Training Capability (TCAoA/JNTC) for FY 2006-2011. In order to meet the current and forecast gaps in Joint and Service training, this decision incorporated: (1) enhancements to the existing and programmed constructive simulations, (2) selected alternative training methodologies, (3)an innovative acquisition prototype, (4) a comprehensive study to re-engineer joint training, and (5) a clear management and oversight structure to meet future Joint training requirements with a selection of robust training tools.

At the July 2004 Australia/US Ministerial Consultations (AUSMIN), the Secretary of Defense (SECDEF) signed an Australian – United States Joint Statement of Principles of Interoperability and affirmed the development of a Joint/Combined Training Center (Capability) (JCTC). The end-state for the JCTC is to enhance high-end

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM

training and enable forces to be exercised in Joint/Combined mission essential tasks in order to increase and measure operational capability and preparedness, improve interoperability, facilitate capability development by identifying specific deficiencies that occur in the gaps and seams and develop recommended solutions, and lastly enhance regional security. The JCTC will be linked to DoD's JNTC as part of the Global Joint Training Infrastructure (GJTI) via USPACOM's Gaming and Simulation Facility (GSF) and eventually USPACOM's Pacific Warfighting Center as a cooperative collection of training sites, nodes, simulations, and events.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	167,107	187,943	186,681
Congressional Action	3,000	-4,900	0
Congressional Undistributed Reductions/Rescissions	-158	-2,937	0
Congressionally Directed Transfer of JFCOM to Defe	0	0	-187,510
Execution Adjustments	2,084	0	0
FY 2005 SBIR	-3,838	0	0
Rate Adjustments	0	0	829
FY 2007 President's Budget Submission	168,195	180,106	0

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: PBD 719 move entire RDT&E funds for FY07 - FY11 to Defense-Wide.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
USJFCOM Joint Concept Development and Experimentation (JCDE) transformation efforts and Campaign Plan focus on high priority tasks identified by the COCOMs and other priorities assigned to USJFCOM through the Transformation Planning Guidance (TPG) and the Chairman of the Joint Chiefs of Staff (CJCS).

Unified Command Plan 2004 (UCP04) directed USJFCOM TO “lead and coordinate the department’s experimentation activities.” Using persistent, continuous experimentation in smaller events that pull together national assets, USJFCOM is agile enough to address current and future issues. USJFCOM Modeling and Simulation Toolbox

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM

supplies joint and coalition tools including complex urban modeling and simulation, providing highly capable and thinking adversaries, and building stronger links with other U.S. agencies and coalition partners.

FY 2006 Priorities
- Joint Experimental Deployment and Support (JxDS): Develop a concept of operations for a logistics element that can synchronize logistics to satisfy operational taskings.
- Joint Information Superiority (JxI): Improve our ability to effectively use Information Operations (IO) and Information Dominance(ID) for the Joint Force Commander.
- Multinational Experimentation and Engagement: Improve our ability for the unified action efforts of our coalition partners.
- Security and Stability Operations: Provide the JFC the ability to expand situational security and create conditions from which stability can grow.
- Joint Urban Operations: Develop the ability for the JFC to deliver information-based precision operations and effects in the complex environment of urban terrain, including denying sanctuary in the urban setting.
- Other areas in concept development include Major Combat Operations, Strategic Deterrence, Homeland Security and Joint Forcible Entry Operations for Full Spectrum Operations.

For Joint Training Modeling and Simulations Development, the overall program goal is to develop capabilities in joint simulations to eliminate COCOM identified training gaps and to provide the joint training environment with the ability to insert emerging technology or enhance existing systems to support joint training requirements. Examples of capabilities to be developed/enhanced are common database format, terrain simulation, After Action Review process for simulation, Run Time Infrastructure component for distributed simulation, and C4I interfaces.

The JNTC will establish a robust research, development, and demonstration program to ensure that the latest S&T are incorporated quickly into Defense knowledge and superiority capabilities, as well as into globally distributed mission rehearsal and joint training systems. S&T improvements will stimulate spiral development processes in the areas of Global Joint Training Infrastructure and Advanced Training Technologies. Using database tracking and knowledge management to keep abreast of ongoing S&T programs and demonstrations, the JNTC will conduct an advanced training technology program to develop new joint training capabilities that address defined operational training requirements and known technology shortfalls.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM

1. Joint Experimental Deployment and Support (JxDS)
- (JxDS) Operational Assessment Plan
- (JxDS) Training Plan for United States Forces, Korea (USFK)
- JxDS Plan for Demonstration for Reception, Staging, Onward movement and Integration (RSOI) ’06
- Finalized JxDS Concept of Operation
- JxDS for USFK (Initial Operational Capability (IOC))
- Start Transition Plan

2. Security, Stability, Transition and Reconstruction Operations
- Improve capability to plan, coordinate, and execute security, stability, transition, and reconstruction within an area of responsibility

3. Joint Urban Operations (JUO)
- Identify means and potential capabilities to deny sanctuary for irregular warfare in urban environments

4. Multinational Engagement and Experimentation
- Conduct Multi-National Experiment 4
- Improve the Multi-National information Sharing (MNIS) capability to fuse and share mission related information with multi-national (MN) and Interagency (IA) partners through policy and technology
- Improve capability to include MN and IA organizations in a coordination and collaboration process

5. Joint Mission Modeling Tools (JMMT)
- Enhance the virtual, live and constructive environment for JCD&E by adding modules to the federation that are applicable to irregular warfare and the urban terrain including political, military, economic, social, information and infrastructure (PMESII)

6. Joint Experimental Information (JxI)
- Improve integration of the elements of IO and ID

7. JNTC
- Establish collaborative agreements with external scientific and technical organizations to integrate and leverage their initiatives with ongoing JNTC efforts.
- Evaluate new and emerging industry and government technologies in the JNTC Advanced Training Technologies laboratory for transition into JNTC training architectures.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM

- Perform system certification testing of training applications in support of the JNTC Accreditation Certification Programs.
- Perform RDT&E in new and emerging technologies, such as, immerse virtual technologies, story driven training, light simulation/federations, massive-multiplayer online games, training objective driven simulations, embedded training, and joint community unique simulations.

8. JCTC
- Complete the JCTC enabling study.
- Publish a JCTC CONOPS for establishing and maintaining through spiral development an integrating architecture that links Australian/US training management systems, training areas, constructive simulations, virtual simulators, headquarters, and units.
- Design the C4I architecture to connect JNTC persistent and nonpersistent sites to the future Australian JCTC Management Centre and outlying Australian training areas.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 2497 PROJECT TITLE: JOINT EXPERIMENTATION VISUALIZATION

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2497 JOINT EXPERIMENTATION VISUALIZATION	163,845	98,170	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Joint Experimentation Campaign Plan focuses on high priority tasks assigned to USJFCOM through the DPG and the Chairman of the Joint Chiefs of Staff (CJCS) instructions on Joint Concept Development and Experimentation. Additionally the top priorities are designed to enable joint support to unified action by experimenting with concepts and prototypes that assist the department in:

1. Deter, detect, engage, and defeat asymmetric global threats.
2. Win Information Superiority fight.
3. Integrate MN capabilities to support Combined Operations.
4. Support interagency planning and execution to accomplish stability, reconstruction and transition operations.
5. Deny sanctuary to threats in complex environments.
6. Rapidly deploy, project and sustain joint capabilities on a global scale.
7. Improve methods and means to integrate and execute Joint Operations.

USJFCOM synchronized Joint and Service efforts in a “battle rhythm” that balances concept development with experimentation and smaller events that are more agile and adaptable. Unified Command Plan 2004 (UCP 2004) strengthened the JCD&E role by directing USJFCOM to “lead and coordinate the department’s experimentation activities.” Additionally, USJFCOM continues to strengthen these tools for conducting joint concept development and experimentation, including scalable parallel processing for modeling and simulation, providing highly capable and thinking adversaries through more effective red teaming initiatives, and building stronger links with other U.S. agencies and potential coalition partners.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 2497 PROJECT TITLE: JOINT EXPERIMENTATION VISUALIZATION

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
JOINT CONCEPT DEVELOPMENT PATHWAY	48,701	45,079	0

FY 2005 Accomplishments:

-Joint Concept Development and Experimentation emphasis for FY 2005 was developing solutions for capability gaps and providing emergent solutions for process shortcomings and operational shortfalls. Future concepts were refined, and discovered capabilities that made a difference for the Joint Task Force Commanders were rushed to the field. Emphasis was on Joint Operations Concepts; Joint Operating Concepts which includes the family of Major Combat Operations, Stability Operations, Strategic Deterrence and Homeland Security; Joint Forcible Entry Operations, Joint Urban Operations, Joint Force Projection and Sustainment for Full Spectrum Operations. These concepts focused on: a) Major Combat Operations against an adversary with a global WMD threat and robust regional anti-access capability; b) joint operations in an urban environment; c) operations against a non-state factor with significant regional combat capability, access to weapons of mass effect, and ties to global terrorist organizations; and d) operations in a faltering or failing state that has regional WMD/effects capability.

FY 2006 Plans:

-Joint Information Superiority (JxI). JFC ability to effectively use information in supporting operations is frequently challenged by existing informational means and approaches to create knowledge across the joint force.
-Multinational Interagency Coordination Group which provides JFC the ability to integrate Multinational and Coalition agencies efforts through collaborative efforts.
-Stability Operations – provide the JFC the ability to expand situational security and create conditions from which stability can grow.
-Joint Urban Operations develop the ability for the JFC to deliver information-based precision operations and effects in the complex environment of urban terrain. Includes denying sanctuary in the urban setting.
-Other areas in concept development include Major Combat Operations, Strategic Deterrence, Homeland Security and Joint Forcible Entry Operations, for Full Spectrum Operations.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 2497 PROJECT TITLE: JOINT EXPERIMENTATION VISUALIZATION

FY 2007 Plans:

-Funds transfer from NAVY to Defense-Wide beginning in FY07.

	FY 2005	FY 2006	FY 2007
JOINT NATIONAL TRAINING CENTER (JNTC) ADVANCED TRAINING TECHNOLOGIES (ATT)	44,873	0	0

FY 2005 Accomplishments:

-Performed research and development within a Live, Virtual, Constructive (LVC) distributed testbed to support the advancement of training technologies in the context of a joint integrated battlespace. The testbed operated as a Continuous Training Research and Development (R&D) Environment and provided the foundation for a distributed & deployable Mission Rehearsal System, which integrated live Intelligence, Surveillance & Reconnaissance (ISR) feeds into the Common Operational Picture (COP). The LVC testbed supported advancement of training technologies, R&D test events, experimentation and interoperability certification assessments. The testbed enabled new training CONOPS to drive efficiency into the planning and conducting of complex joint training events. It also provided capability to identify, evaluate, and solve training system shortfalls. This testbed has been established as a laboratory at USJFCOM and will draw on other facilities through distributed communication links.
-Performed development of Joint Rapid Distributed Database Development System (JRD3S) Initial Capabilities Document (ICD) in support of JCIDS process. Designed, developed, tested and evaluated JRD3S proof of concept.
-Prototyped a knowledge management framework that provides access to digital libraries and distributed learning centers in the centers of excellence to support Standing Joint Force Headquarters training and mission rehearsal.
-Developed a real world database and distribution system for geospatial intelligence data and force data sharing to facilitate training and mission rehearsal capability.
-Developed Opposing Forces (OPFOR) Threat systems to include Service instrumentation, interoperability standards, weapons models, simulated terrain, and virtual training capabilities.
-Developed a joint training Collaborative Information Environment (CIE) Initial Operating Capability (IOC).
-The increase in budget from FY04 to FY05 enabled JNTC to stand up the Joint Advanced Training Technologies Laboratory (JATTL) and the initial contractor support services necessary to establish, operate and maintain the robust RDT&E environment to support the JNTC certification program, “to be” standards and architecture identification and development, and support multiple R&D projects in technical focus areas such as;

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 2497 PROJECT TITLE: JOINT EXPERIMENTATION VISUALIZATION

networking, joint command & control, instrumentation, data collection, after action review, opposing forces technologies, LVC technologies, knowledge management, information management, and training systems operations research.

FY 2006 Plans:

Funding realigned to Project 3153.

FY 2007 Plans:

Funds transfer from Navy to Defense-Wide beginning in FY07.

	FY 2005	FY 2006	FY 2007
JOINT EXECUTABLE CONCEPT REFINEMENT	29,018	32,132	0

Previously known as Standing Joint Force Headquarters (SJFHQ) Enabling Concept in the FY 2005 President's Budget. The title was changed to eliminate confusion with work being done by the Joint Battle Center to support the Standing Joint Forces HQ Interoperability Technical Demonstration Center (ITDC).

FY 2005 Accomplishments:

-During FY 2005 USJFCOM coordinated the Department’s concept development and experimentation refinement efforts.
-USJFCOM worked with national and multinational partners to develop integrate, interoperable, and interdependent military forces that are capable of supporting the GWOT. This included moving the Collaborative Information Environment, Operational Net Assessment and Joint Interagency Control Group, Joint Fires Initiative Block 1 and Logistics Common Relevant Operational Picture to Programs of Record for fielding and lifecycle management.
-New efforts for executable concept refinement experimentation consisted of: Knowledge Advantage, Multinational Information Sharing, Multinational Interagency Group, and Multinational Experiment 4.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 2497 PROJECT TITLE: JOINT EXPERIMENTATION VISUALIZATION

FY 2006 Plans:

-Continue concept refinement activities and identify capabilities mature enough for insertion into COCOM's infrastructure to evaluate capabilities in real world operational environments. USJFCOM goal is to identify maturing applications through experimentation spirals and move them forward into real world situations to provide an increased capability for joint warfighting.
-Knowledge Advantage: Ability to synthesize information into a construct that provides the JFC a strategic and operational edge.
-Multinational and Coalition Information Sharing: Synthesis and multi level stratified information sharing applications through portal technology.
-Multinational Forces: Iraq Portal deployed and utilized in Iraq.
-Multinational Interagency Group: Current methodologies for interagency coordination and information sharing will not support Joint Force operations across the full spectrum of engagement and leveraging to include non governmental and multinational agencies for Diplomatic, Information, Military and Economic (DIME) applications.
-Expand and continue multinational experimentation for multinational and coalition integration and operations coherently across the JFC operational needs.
-Multinational Experiment 5: Expand and continue multinational and coalition integration and operations coherently across the JFC's operational needs.

FY 2007 Plans:

-Funds transfer from NAVY to Defense-Wide beginning in FY07.

	FY 2005	FY 2006	FY 2007
JOINT SIMULATION SYSTEM (JSIMS)	13,790	0	0

* Funds realigned from PE 0603757N in FY 2005 and out.
* Funds realigned to Project 3149 in FY 2006.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 2497 PROJECT TITLE: JOINT EXPERIMENTATION VISUALIZATION

FY 2005 Accomplishments:

-Based upon findings from the recent Training Capabilities AoA, JWC developed additional enhancements to constructive simulations designed to eliminate training gaps identified in the needs analysis. Additionally, funds development and integration efforts were developed to close COCOM training gaps in the constructive modeling and simulation environment. The focus of these enhancements was on high priority needs such as: mission rehearsal support by improving rapid database development, replication of non-kinetic processes, building adaptable constructive training systems, enhancing strategic context, support for multi-echelon training, and emerging concepts and missions. This increased capabilities to support Joint training requirements quickly by providing JFCOM the ability to insert an emerging technology or reuse existing systems in the constructive training architecture. These enhancements reduced long-term life cycle costs; increase scalability, composability, and reliability by focusing development efforts. Joint training requirements drove capabilities development within the joint training federations. The training simulations included representations and products from the intelligence community that will incorporate intelligence as part of the warfighting/training audience. Funding for the limited simulation enhancement begins to close training gaps in the training environment by eliminating unnecessary redundancy, incorporating automated tools, and increasing commonality in the Joint training simulation toolkit. The JWC Joint Development and Integration and Software Support Facilities performed software Configuration Management (CM) which ensures users are operating the most current versions of simulation software in Joint Exercises. The CM team documented upgrades/fixes to the software and publish those changes to the user community at large. Real-time technical support to Joint Exercise and other training or testing events were provided to insure the Joint training federations operate as delivered, taking steps to correct real-time problems that arise. Specific training (technical and operational) was provided to users prior to conducting a Joint Federation-driven Joint Exercise. Periodic upgrade training was provided to user sites, and training was provided for periodic model testing events, as required. The facilities maintained and controlled all Joint models and federation software and documentation in a central location (resource repository) and served as an archive for historical documentation. Perfunctory Software administrative support (considered specialized and technical) was provided to the above functions, to include organic security and engineering expertise.

FY 2006 Plans:

Funding realigned to Project 3149.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 2497 PROJECT TITLE: JOINT EXPERIMENTATION VISUALIZATION

FY 2007 Plans:

Funding transfer from Navy to Defense-Wide beginning in FY07.

	FY 2005	FY 2006	FY 2007
JOINT DEPLOYMENT, EMPLOYMENT AND SUSTAINMENT (JDES)	8,290	8,604	0

FY 2005 Accomplishments:

-Continued JDES initiatives focused on next near term ready applications and next decade capabilities. Joint Force Projection and Sustainment allowed the deployment, employment and sustainment of joint forces conducting distributed and non-contiguous operations, in an anti-access or area denial environment.
-Developed Joint Basing Alternatives: Provided a mix of alternative solutions to the JFCs that increased options for supporting distributed operations under various conditions. Currently the JFC does not have adequate force projection and sustainment alternatives in anti-access conditions. Distributed operations requires capabilities that include extended operational reach, overseas basing, and joint sea basing to provide alternative approaches to force projection and sustainment of the joint force.

FY 2006 Plans:

-Begin design work on a “blank sheet of paper” next generation logistics system. Construct is to work a new process, procedure and system that is not bogged down by the non-integrated multiple logistics systems currently in place.
-Continue efforts to meet Basing Alternatives, Force Projection, and Sustainment.
-Provide focused logistics concept development for operating in an adaptive, elastic and ubiquitous distribution-based sustainment system along with the required information architecture to provide and receive time-definite support measured in hours, not days and weeks. Establish a joint sustainment force that is rapidly deployable, fully capable, immediately employable, and responsive to supported forces.
-Joint Experimental Deployment and Sustainment: Develop a construct for joint force asset visibility allowing adaptive planning and application of the joint force as well as ensure sustainment operations occur logically and timely.
-Joint Deployment Systems Business Process Reengineered Prototype Implementation: Process workflow portal to manage the deployment and sustainment of forces for 1) increased effectiveness to deploy and sustain forces in execution of joint operations; 2) enterprise application integration platform to share data and tools and 3)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 2497 PROJECT TITLE: JOINT EXPERIMENTATION VISUALIZATION

established functional and technical development “battle rhythm” to delivery rapid operational spirals providing enhanced transformation change solution sets to the warfighter every 9-12 months.
-Joint Deployment Data Transparency: Develop the start point for joint deployment common data model/data standards, and Extensible Machine Language (XML) data schema for shared data and increased system to system interoperability, and provide the strategic framework to plan, influence acquisition, and sustain Joint Deployment Capability for the development and management execution of an Integrated Master Plan and Integrated Master Schedule.

FY 2007 Plans:

-Funds transfer from NAVY to Defense-Wide beginning in FY07.

	FY 2005	FY 2006	FY 2007
INTEGRATION WITH OTHER REGIONAL COMBATANT COMMANDERS, MILITARY SERVICES AND AGENCIES	7,254	7,971	0

FY 2005 Accomplishments:

-Applied joint context to assist in developing and defining joint operation concepts used by Joint, Interagency and Multinational warfighting community. Key venues for incorporating these integration activities include Pinnacle Impact, Unified Quest, Unified Course, Thor’s Hammer, Unified Engagement, Joint Urban Warrior, Multinational Experiment 4, and Sea Viking. This approach ensured common, consistent and transparent joint data, tools, services, joint analysis and metrics. Areas under consideration and evaluation include Interagency Incident Management Teams, Global Architecture Intelligence, and incorporation of Department of State support to operations.

FY 2006 Plans:

-Continue all efforts of FY 2005.
-Ensure all joint warfighting capability needs of combatant commanders are addressed in experimentation efforts.
-Identify emerging capability gaps identified by ongoing operations.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 2497 PROJECT TITLE: JOINT EXPERIMENTATION VISUALIZATION

FY 2007 Plans:

-Funds transfer from NAVY to Defense-Wide beginning in FY07.

	FY 2005	FY 2006	FY 2007
INNOVATION AND EXPLORATION	6,737	7,766	0

FY 2005 Accomplishments:

-Expanded efforts to tie department joint science and technical efforts to identified joint warfighting capabilities gaps.
-Continued using the analytical model to rapidly assess new ideas. Innovation and exploration efforts continued for 2025-2040 timeframe. Investigation continued in areas of application of nano-biotechnology, knowledge workers, unmanned effects, and multinational information sharing, among others.

FY 2006 Plans:

-Continue to expand efforts to tie Department Joint science and technical efforts to identified joint warfighting capabilities gaps.
-Investigate in areas of application, such as swarming entities, use of compressive receivers in detecting and locating “hard-to-get” threat emitters, medical operations transformation, and pattern recognition for time-critical targeting, near space applications, special weapons and effects assessment.

FY 2007 Plans:

-Funds transfer from NAVY to Defense-Wide beginning in FY07.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 2497 PROJECT TITLE: JOINT EXPERIMENTATION VISUALIZATION

	FY 2005	FY 2006	FY 2007
MULTI-NATIONAL AND COALITION CONCEPT DEVELOPMENT	5,182	5,351	0

FY 2005 Accomplishments:

-Developed experimental concept integration with operational partners.
-Continued exploring the MN concept of operations, engagement, education and collaboration with our MN partners. USJFCOM continued to increase the visibility of our MN partners needing access to vital information and emphasizing system technology improvements in MLS. USJFCOM will be expanding the current experiment audience beyond the MN Interoperability Council members (current members include: Australia, Canada, France, Germany, United Kingdom and North Atlantic Treaty Organization). Potential additional countries include Finland, Sweden, and Japan among others.

FY 2006 Plans:

-Build upon lessons learned from real world and experimental coalition experimentation. Work on Content-Based Information Security and other options to fully engage our partners in the ways and means of joint/coalition warfighting. MN experimentation efforts will include work with other nations to identify and support coalition operations with leading technology or innovations from their national capabilities to export across the coalition collaborative needs.

FY 2007 Plans:

-Funds transfer from NAVY to Defense-Wide beginning in FY07.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 3145 PROJECT TITLE: JOINT COMBINED TRAINING CENTER (JCTC)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
3145 JOINT COMBINED TRAINING CENTER (JCTC)	0	4,925	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: At the July 2004 Australia/U.S. Ministerial Consultations (AUSMIN), the SECDEF signed an Australian – United States Joint Statement of Principles of Interoperability and affirmed the development of a Joint/Combined Training Center (Capability) (JCTC). The end-state for the JCTC is to enhance high-end training and enable forces to be exercised in Joint/Combined mission essential tasks in order to increase and measure operational capability and preparedness, improve interoperability, facilitate capability development by identifying specific deficiencies that occur in the gaps and seams and develop recommended solutions, and lastly enhance regional security. The JCTC will be linked to DoD's Joint National Training Capability (JNTC) as part of the Global Joint Training Infrastructure (GJTI) via USPACOM's Gaming and Simulation Facility (GSF) and eventually USPACOM's Pacific Warfighting Center as a cooperative collection of training sites, nodes, simulations, and events.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
JOINT COMBINED TRAINING CENTER (JCTC)	0	2,090	0

FY 2006 Plans:

-Program Study and/or a series of Planning and Design studies of desired capabilities as described in JCTC Scoping Study.
-Connectivity between USPACOM and Australia JCTC Management Center (ADFWC).
-Prepare ranges as described in JCTC Scoping Study to support Proof of Concept during Talisman Saber 07.
-Lease, borrow, and transport architecture elements of a deployable and/or permanent Live and Constructive environments to support Proof of Concept during Talisman Saber 07.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 3145 PROJECT TITLE: JOINT COMBINED TRAINING CENTER (JCTC)

FY 2007 Plans:

-Funds transfer from NAVY to Defense-Wide beginning in FY07.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 3149 PROJECT TITLE: JOINT TRAINING

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
3149 JOINT TRAINING	0	23,221	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Secretary of Defense PDM (dated 12 Dec 2003) tasked USJFCOM with the responsibility for maintaining JSIMS software and establishing a SSF at the JWFC, pending the results of an AoA. As a result of the AoA findings, JWFC will fund development capabilities in joint simulations to eliminate COCOM identified training gaps. The center provides the joint training environment with the ability to insert emerging technology or enhance existing systems in the constructive training architecture. In accordance with UCP 04, JWFC-JFCOM leads the development and operation of systems and architectures that directly support distributed joint training requirements of other COCOMs, Joint Task Forces (JTFs) and Defense Agencies.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
JOINT SIMULATION SYSTEM (JSIMS)	0	12,821	0

* FY 2005 was funded under Project 2497.
* Funding was realigned from PE 0603757N in FY 2005 and out.

FY 2006 Plans:

-Continue all efforts of FY 2005 (Project 2497) to develop and enhance capabilities in constructive simulations to support Joint training.

FY 2007 Plans:

-Funds transfer from NAVY to Defense-Wide beginning in FY07.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 3149 PROJECT TITLE: JOINT TRAINING

	FY 2005	FY 2006	FY 2007
TRAINING CAPABILITY ANALYSIS OF ALTERNATIVES JOINT NATIONAL TRAINING CAPABILITY (TCAOA/JNTC)	0	4,502	0

FY 2006 Plans:

-Initiate and conduct a proof of principle test, initially deliver this capability to two COCOMs. This effort will provide organic Observer/Trainers and training support tools to the COCOMs in order to execute their statutory requirement to conduct individual and staff training for assigned forces. Current Joint training is centered on exercises supported by federations of Joint and Services constructive simulations. Additionally, COCOMs require resources to plan, execute, and assess training for the individuals and staffs of Joint Force Commands, Standing Joint Force Headquarters, and Joint Task Forces.
-Initiate and conduct a limited three-year prototype to explore innovative acquisition strategies, which can provide a model for more cost effective acquisition of training tools and contractor support services.

FY 2007 Plans:

-Funds transfer from NAVY to Defense-Wide beginning in FY07.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 3153 PROJECT TITLE: JOINT NATIONAL TRAINING CAPABILITY (JNTC)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
3153 JOINT NATIONAL TRAINING CAPABILITY (JNTC)	0	46,190	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Management Initiative Decision 906 (dated 12 Jan 2003) directed US Joint Forces Command (USJFCOM) to establish the Advanced Training Technologies (ATT) group to support JNTC operations. The mission is to develop the robust RDT&E capabilities that integrate Live, Virtual and Constructive (LVC) elements into a seamless joint training environment. JNTC creates joint warfighting conditions through a networked collection of interoperable training sites, ranges and nodes that synthesize personnel, doctrine and technology to deliver and achieve “Joint Context” to COCOM and Service training requirements.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
JOINT NATIONAL TRAINING CENTER (JNTC) ADVANCED TRAINING TECHNOLOGIES (ATT)	0	46,190	0

* FY 2005 was funded under Project 2497.

FY 2006 Plans:

-Continue all efforts of FY 2005 (Project 2497) except work on CIE.
-Develop Joint After Action Review tool set.
-Integrate AF/Navy P5 instrumentation capability into joint training environment.
-Enhance and integrate space domain representations into joint training environment.
-Develop and integrate CBRNE capability into joint training environment.
-Perform RDT&E in new and emerging technologies, such as, immerse virtual technologies, story driven training, light simulation/federations, massive-multiplayer online games, training objective driven simulations, embedded training, and joint community unique simulations.
-Perform migration testing of training applications to Global Information Grid infrastructure.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 3153 PROJECT TITLE: JOINT NATIONAL TRAINING CAPABILITY (JNTC)

FY 2007 Plans:

-Funds transfer from NAVY to Defense-Wide beginning in FY07.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
JOINT EXPERIMENTATION VISUALIZATION	0	2,000

Funds in support of Joint Experimentation Visulaization resources.

	FY 2005	FY 2006
LOCATION SPECIFIC DIGITAL FINGERPRINTING (LSDF)	1,446	0

The Location Specific Digital Fingerprint (LSDF) was a digital authentication tool that destroyed the capabilities of hacker tools by introducing physics into the computer security equation and offered true security for both wired and wireless networks. In addition to providing unpredictable random numbers that cannot be tracked by hackers, the LSDF also yielded specific information about the environment around a computer which allowed the identification of the space around it. The LSDF system allowed the introduction of the strongest security and access control required by the government for use in National Security Systems and has significant positive impacts in protecting U. S. critical infrastructure.

	FY 2005	FY 2006
MODELING AND SIMULATION FOR URBAN OPERATIONS	0	5,600

Funds in support of Modeling and Simulation for Urban Operations resources.

	FY 2005	FY 2006
PLAYAS TECHNICAL INSTRUMENTATION NETWORK DESIGN AND DEVELOPMENT	2,904	0

The New Mexico Institute of Mining and Technology (NM Tech) Director, Energetic Materials Research and Testing Center (EMRTC) worked with JNTC on the “Playas Instrumentation Network Design and Development.” This related to the town of Playas, NM, recently acquired by NM Tech. The town is being converted into a training and RDT&E complex, initially supporting training by the Department of Homeland Security, and also supporting urban operations training for an Army Stryker brigade (172nd Infantry Brigade) preparing for deployment to Iraq.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: NAVY TECHNICAL INFORMATION PRESENTATION SYSTEM
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

JNTC equity in this project was focused on the requirement for interoperability of distributed instrumentation systems. Interoperability requirements can and will be folded into the development of the Instrumentation Network Master Plan. This addressed instrumentation in the Urban Environment and interagency efforts within the scope of training transformation. JFCOM worked with the project execution organizations to ensure that products and activities were integrated into the overall JNTC effort and are compatible with JNTC standards in support of interoperability.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N
PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	68,351	59,327	17,982	10,607	12,448	12,563	12,738
2914 WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	19,146	15,827	17,982	10,607	12,448	12,563	12,738
9999 CONGRESSIONAL PLUS-UPS	49,205	43,500	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports the development and demonstration of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care, or the logistics of providing self/buddy-carried, life saving technologies for massive battlefield wounds. The National Institutes of Health (NIH) focuses on the basic science of disease processes, not product development. Programs are complementary with those of the Army and are coordinated through the Armed Services Biomedical Research Evaluation Management (ASBREM) Committee to prevent duplication of effort. This project funds the Force Health Protection Future Capability (FHPFC) Program (formerly titled Warfighter Protection Future Naval Capability) and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike".

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N
PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	66,868	16,068	16,835
Congressional Action	0	43,500	0
Congressional Undistributed Reductions/Rescissions	-52	-241	0
Execution Adjustments	2,900	0	0
FY 2005 SBIR	-1,378	0	0
Program Adjustments	13	0	0
Program Realignment	0	0	1,081
Rate Adjustments	0	0	66
FY 2007 President's Budget Submission	68,351	59,327	17,982

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
Efforts within this PE support the Future Naval Capabilities (FNC) program and are monitored at two levels. At the lower level, each is measured against technical and financial milestones on a monthly basis. Annually, each FNC project is reviewed in depth for technical and transition performance by CNR against requirements approved by the Navy's senior flag level Technical Oversight Group. Routine site visits to performing organizations are conducted to assess programmatic and technical progress. Most are reviewed annually or bi-annually by an independent board of visitors who assess the level and quality of the Science and Technology

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N
PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

basis for the project. Several of these projects support specific Defense Technology Objectives (DTO) established by the Director, Defense Research and Engineering (DDR&E) and receive a bi-annual technical and programmatic review under DDR&E's Technology Area Review Assessment Program.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2914 PROJECT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2914 WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	19,146	15,827	17,982	10,607	12,448	12,563	12,738

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project supports the development and demonstration of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care, or the logistics of providing self/buddy-carried, life saving technologies for massive battlefield wounds. The National Institutes of Health (NIH) focuses on the basic science of disease processes, not product development. Programs are complementary with those of the Army and are coordinated through the Armed Services Biomedical Research Evaluation Management (ASBREM) Committee to prevent duplication of effort. This project funds the Force Health Protection Future Capability (FHPFC) Program (formerly titled Warfighter Protection Future Naval Capability) and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike". Due to the number of efforts in this PE, the projects described herein are representative of the work included in this PE.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
CASUALTY CARE AND MANAGEMENT	7,440	7,700	8,585

The goal of Casualty Care and Management is to maximize the continuum of care with lifesaving interventions as far forward as possible, in an increasingly lethal battlespace, with reduced infrastructure and logistics.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2914 PROJECT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

FY 2005 Accomplishments:

- Continued development of drugs and devices for treatment of uncontrolled hemorrhage in the far forward battlefield. Blood loss is the leading cause of preventable death in combat.
- Continued studies into the safety of hypotensive resuscitation to support development of resuscitation fluids that enhance cardiovascular function, tissue perfusion and oxygen delivery. Improved resuscitation fluids are needed to prevent casualty deaths from shock and associated tissue/organ damage.
- Continued development of medical devices to monitor patient status and identify casualties in danger of progressing into hemorrhagic shock. This will improve triage decisions and allocation of medical evacuation resources.
- Continued identification of Food and Drug Administration (FDA) approved products as well as new development of novel therapeutics that protect against the induction of hemorrhagic shock. A reduced need for resuscitation fluids would significantly reduce the medical logistical burden for Naval forces.
- Continued development of casualty management tools and data. These tools and data are required by combat, material development, and medical planners to evaluate the effectiveness of personal protection systems and healthcare support services, and to project future material and training requirements.
- Continued development of an effective analgesic for controlling severe pain that does not have the adverse effects of morphine (cardiorespiratory depression, sedation) or the addiction potential. Naval casualties are expected to “stay in the fight” as long as possible and the use of morphine removes that capability.

FY 2006 Plans:

- Continue all efforts of FY 2005.
- Initiate development of therapeutic interventions in wound management. Focus is to reduce morbidity resulting in a quicker return to duty and to reduce requirement for medical resources.
- Initiate development of a device to rapidly type, cross-match and identify pathogens in fresh whole blood.

FY 2007 Plans:

- Continue all efforts of FY 2006 and expand treatment of uncontrolled hemorrhage effort.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2914 PROJECT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

	FY 2005	FY 2006	FY 2007
CASUALTY PREVENTION	7,479	6,971	7,452

Casualty Prevention includes enhancing warfighter situation awareness and countering threats from disease, battle and non-battle injuries.

FY 2005 Accomplishments:

- Continued development of protective personal gear and physiologic monitoring ensembles to reduce injury risk and enhance personnel safety in warm and cold water operations for Navy divers and completed development of gear for shipboard firefighting and damage control operations and extreme aircraft operations (g-force, altitude and heat protection).
- Continued development of improved hearing protection systems, compounds, and techniques for personnel supporting aircraft operations. Completed animal research on cochlear microdialysis for treatment of hearing loss. This effort was previously accounted for in the Healthy and Fit Force activity.
- Continued development of tools to predict injury related to thermobaric and conventional blast. Understanding the mechanisms involved with organ and neurological damage due to blast is crucial to developing effective protective equipment.
- Completed development of the capability to provide protection of aircrews from laser attacks. No laser protection capability exists for daytime/nighttime protection of aircrew from tunable frequency lasers.
- Completed effort to develop noninvasive diagnostic tests for diseases that produce results in minutes, not hours or days.
- Initiated research into understanding neurological and cognitive effects of blast injuries. There is an increasing amount of information related to the correlation of closed-head blast injury with cognitive and motor deficits as well as long term emotional problems such as Post-Traumatic Stress Disorder (PTSD).
- Initiated research on return-to-duty criteria for heat injury patients.
- Initiated development of decision support tools for controlling disease and non-battle injuries on Navy vessels. Current tools are not targeted at the General Medical Officer and do not focus on human behavioral models.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2914 PROJECT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete development of tools to predict injury related to thermobaric and conventional blast.
- Complete development of decision support tools for controlling disease and non-battle injuries on Navy vessels.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above and expand neurological effects of blast effort.
- Complete research on return-to-duty criteria for heat injury patients

	FY 2005	FY 2006	FY 2007
HEALTHY AND FIT FORCE	4,227	1,156	1,945

Healthy and Fit Force efforts preserve health and enhance fitness of ready forces against physical and psychological threats through the continuum of peace and war.

FY2006 to FY2007 increase due to continuation/expansion of ongoing efforts.

FY 2005 Accomplishments:

- Continued identification of factors and causes of injury in shipboard and aviation scenarios, and development of exposure guidelines and engineering specifications for preventing mechanical shock-related injury. Muskuloskeletal injury has a major impact on force readiness and warfighter health. Completed initial estimates of factors and solutions for mitigating shock-related injury in Mark V boats.
- Initiated development of treatments for acute warfighter mental health issues. Combat related psychological trauma has been shown to be a major detriment to retention and force readiness.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 2914 PROJECT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

FY 2006 Plans:

- Continue all efforts of FY 2005.

FY 2007 Plans:

- Continue all efforts of FY 2006.

C. OTHER PROGRAM FUNDING SUMMARY:
RELATED RDT&E:

NAVY RELATED RDT&E:
PE 0601153N Defense Research Sciences
PE 0602235N Common Picture Applied Research
PE 0602236N Warfighter Sustainment Applied Research
PE 0603236N Warfighter Sustainment Advanced Technology
PE 0604771N Medical Development

NON-NAVY RELATED RDT&E:
PE 0602716A Human Factors Engineering Technology
PE 0602785A Manpower/Personnel/Training Technology
PE 0602787A Medical Technology
PE 0603002A Medical Advanced Technology
PE 0602202F Human Effectiveness Applied Research
PE 0603231F Crew Systems and Personnel Protection Technology

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
ADVANCED WARFIGHTER PROTECTION - COMPOSITE TISSUE TRANSPLANT	0	1,700

This effort supports advanced warfighter protection - composite tissue transplant research.

	FY 2005	FY 2006
ANTIOXIDANT MICRONUTRIENT PROGRAM FOR WARFIGHTER EXPOSURE	589	1,000

Effort evaluated protective effects of a series of antioxidant micronutrient against the adverse effects of blast injuries, ionizing radiation, and hyperbaric oxygen exposures.

	FY 2005	FY 2006
AUTHENTIC TACTICAL FLIGHT SIMULATOR OPERATIONAL VALIDATION	0	1,350

This effort supports authentic tactical flight simulator operational validation research.

	FY 2005	FY 2006
BATTLEFIELD PHARMACEUTICAL TEST	964	0

Effort supported continued development of a pharmaceutical to be used for the resuscitation of combat casualties.

	FY 2005	FY 2006
C. W. BILL YOUNG BONE MARROW R&D PROGRAM	0	30,000

This effort supports the C. W. Bill Young Bone Marrow R&D Program.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
HEMOSTATIC RESEARCH	964	0

Effort developed a hemostatic agent to rapidly control moderate to severe hemorrhage thereby preventing excessive blood loss in combat casualties. The Navy and Marine Corps will benefit from an inexpensive, easy to use, agent to prevent excessive blood loss in combat casualties.

	FY 2005	FY 2006
HIGH SPEED BLOOD AND FLUID TRANSFUSION EQUIPMENT	1,446	2,100

FY 2005 - Effort supported blood and fluid infusion/transfusion technology.

FY 2006 - This effort supports high speed blood and fluid transfusion equipment research.

	FY 2005	FY 2006
IMPLANTABLE MIDDLE-EAR HEARING SYSTEM	1,446	0

Effort developed a fully-implantable middle-ear transducer technology for use in treatment of noise-induced hearing loss (NIHL).

	FY 2005	FY 2006
INDIVIDUAL WATER PURIFICATION (IWP) PROGRAM	2,893	0

Effort delivered a device that will produce Ringer’s lactate resuscitation fluid for injection utilizing any water source (pond, puddle, well, etc).

	FY 2005	FY 2006
INTEGRATED WARFIGHTER BIODEFENSE PROGRAM	0	3,750

This effort supports integrated warfighter biodefense program research.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
NATIONAL BONE MARROW PROGRAM	28,981	0

Effort supported the National Marrow Program/Registry, funding research associated with transplantation. Research supported new understanding of tissue typing techniques and reduced rejection rates in bone marrow transplant patients.

	FY 2005	FY 2006
NAVAL SPECIAL WARFARE PERFORMANCE AND INJURY PREVENTION PROGRAM	0	1,000

This effort supports Naval special warfare performance and injury prevention program research.

	FY 2005	FY 2006
NAVY MEDICAL SYSTEM CONFIGURATION AND TEST BED (NMSCTB)	5,048	0

Effort established a capability for expediting the delivery of emerging technologies from Navy Medical (R&D) efforts to DoD healthcare. Force health protection technologies developed by the Naval Health Research Center (NHRC) are undergoing further development and systems integration prior to actual field-testing. Effort involved integration into NHRC Integrated Suite of Technologies, development of the capability to import data from other models, and model validation in exercises.

	FY 2005	FY 2006
NURSING TELEHEALTH RESEARCH PROGRAM	2,507	2,600

FY 2005 - Effort established an international consortium of military medical technicians, educators, researchers, and domestic rural health care providers to design and deliver a nurse training curriculum to remote international locations with special emphasis on emergency medical training and humanitarian relief. Efforts established a beta test of the Virtual Clinical Practicum between Walter Reed Army Medical Center and Mount Aloysius College, implemented and evaluated a “Smart Classroom” initiative, and conducted a telehealth-based research study for high cost diabetic patients.

FY 2006 - This effort supports the Nursing Telehealth Research Program.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
ORGAN TRANSPLANT TECHNOLOGY	1,954	0

Performed trials of newly developed immune therapies designed to achieve tolerance to transplanted tissues without the need for continuous immunosuppression. Continued advanced animal studies to meet necessary requirements in preparation for clinical trials.

	FY 2005	FY 2006
TISSUE AND LIMB TRANSPLANTATION MEDICAL TECHNOLOGY DEVELOPMENT	2,413	0

Effort supported tissue and limb transplantation medical technology development.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	36,949	35,110	35,055	54,160	54,773	54,968	54,954
2916 UNDERSEA WARFARE ADVANCED TECHNOLOGY	30,296	27,160	35,055	54,160	54,773	54,968	54,954
9999 CONGRESSIONAL PLUS-UPS	6,653	7,950	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All Navy advanced technology development in undersea target detection, classification, localization, tracking and neutralization is funded through this Program Element (PE). The related technologies being developed are aimed at enabling Sea Shield, one of the three core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new Anti-Submarine Warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. The focus is on leveraging technologies that will protect the country’s current capital investment in surveillance, submarine, surface ship and air ASW assets.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	33,087	27,603	35,520
Congressional Action	0	7,950	0
Congressional Undistributed Reductions/Rescissions	-26	-443	0
Execution Adjustments	4,391	0	0
FY 2005 SBIR	-509	0	0
Program Adjustments	6	0	0
Program Realignment	0	0	-404
Rate Adjustments	0	0	-61
FY 2007 President's Budget Submission	36,949	35,110	35,055

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Project Morgan funding for FY 2005-07 was transferred from PE 0603747N (BA 3) to 0603734N (BA 4). This funding transfer creates a downward funding profile in PE 0603747N.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The overall metrics of advanced research in undersea warfare are to develop technologies aimed at improving target detection, classification, localization, tracking, increasing attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments, countering enemy torpedoes, providing the ability to conduct long-range engagements, increasing weapons load-out, providing multi-platform connectivity, increasing endurance/survivability, and reducing size and power requirements.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2916 UNDERSEA WARFARE ADVANCED TECHNOLOGY	30,296	27,160	35,055	54,160	54,773	54,968	54,954

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: All Navy advanced technology development in undersea target detection, classification, localization, tracking and neutralization is funded through this project. Technologies being developed within this project are aimed at enabling Sea Shield, one of the three core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new ASW operational concepts that promise to improve wide-area surveillance, detection, localization, tracking and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship and air ASW assets.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
WIDE AREA ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE	7,710	12,564	22,909

Wide Area ASW Surveillance is focused on dramatically improving the capability to sanitize large areas relative to the capabilities of legacy ASW sensors. Efforts include the development of affordable off-board systems with associated processing and robust, high-bandwidth communications links. The cornerstone of Wide Area ASW Surveillance is the ability to rapidly distribute sensors from air, surface and sub-surface platforms as well as to develop long-endurance sensors and unmanned ASW vehicles. This activity represents a shift from traditional fixed surveillance systems to autonomous, networked, multi-static operation, supported by passive/active signal processing with the objective of increased detection capabilities. This activity includes support to Project Morgan the details of which are classified. Project Morgan funding transferred to PE 0603734N, Project 1804 in FY 2005 through FY 2007.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

As described under the Cooperative ASW Activity, beginning in FY 2005 testing and demonstrations associated with LWAD will be reported as part of the overall technologies being tested/demonstrated in this PE. As a result, funding no longer is reported under Cooperative ASW, rather it is included in the other activities. This change causes an additional shift among the R-2 Activities.

FY 2005 Accomplishments:

- Continued development of multistatic sonar signal classification algorithms for coherent sources.
- Continued concept of operations development and performance requirements for multistatic sonar employing remotely operated sound sources and receivers
- Continued at-sea demonstrations and data collections with the Compact Deployable Multistatic Receiver (CDMR) Advanced Development Model (ADM).
– Continued development and testing of Deployable Autonomous Distributed System (DADS) technologies in preparation for a barrier demonstration.
– Continued planning for and conduct of DADS barrier demonstration. - Initiated the writing of DADS system documentation.

FY 2006 Plans:

- Continue all FY 2005 efforts less those noted as completed.
- Complete development of multistatic sonar signal classification algorithms for coherent sources.
- Complete concept of operations development and performance requirements for multistatic sonar employing remotely operated sound sources and receivers.
- Complete development and testing of Deployable Autonomous Distributed System (DADS) technologies in preparation for a barrier demonstration.
- Complete planning for and conduct of DADS barrier demonstration.
- Complete writing of the DADS system documentation.

FY 2007 Plans:

- Continue all other FY 2006 efforts less those noted as completed.
- Continue Submarine Track and Trail-Baseline advanced research efforts in the areas of advanced undersea sensors, communications, and autonomy. This effort transferred to this PE from PE 0603114N due to Enabling Capability realignments.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

- Complete at-sea demonstrations and data collections with the CDMR ADM.
- Complete integrated at-sea testing of the multistatic system components (CDMR, Compact Deployable Multistatic Source, signal processing software, and “field-level” processing). This effort transitioned to this PE from PE 0602747N.
- Complete DADS deployment study to investigate various tactical deployment options. This effort transitioned from PE 0602747N.
- Initiate DADS deployment feasibility effort.
- Initiate testing of the PALANTIR (A non-acoustic surveillance system) sensor system.
- Initiate tactical test planning for the PALANTIR sensor.
- Initiate development of active sonar sensors and processing for wide area surveillance of deep ocean operating areas.

	FY 2005	FY 2006	FY 2007
BATTLEGROUP ANTI-SUBMARINE WARFARE (ASW) DEFENSE	5,362	14,596	8,618

Battlegroup ASW Defense technology focuses on the development of platform-based sources and receivers aimed at denying submarines the ability to target grey ships. This technology area is primarily concerned with detections inside 10 nautical miles. Battlegroup ASW Defense integrates next-generation technologies, automatic target recognition, sensors that adjust to complex acoustic environments, and environmentally adaptive processing techniques. Battlegroup ASW Defense will enable smaller, lighter, and cheaper arrays, large multi-line arrays, and submarine flank arrays all with environmental adaptation capabilities. This activity includes support to Project Morgan, the details of which are classified. Project Morgan funding transferred to PE 0603734N, Project 1804 in FY 2005 through FY 2007.

As described under the Cooperative ASW Activity, beginning in FY 2005 testing and demonstrations associated with LWAD will be reported as part of the overall technologies being tested/demonstrated in this PE. As a result, funding no longer is reported under Cooperative ASW, rather it is included in the other activities. This change causes an additional shift among the R-2 Activities.

FY 2005 Accomplishments:

- Continued development, demonstration and transition of Sonar Automation Technology (SAT) threat submarine detection and classification algorithms.
- Continued a performance evaluation of a Counter Torpedo Detection, Classification, and Localization (CTDCL)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

prototype torpedo protection system capable of countering two torpedoes launched in rapid succession.
- Initiated integration of CTDCL processing with advanced sensors for outyear transition to the AN/WSQ-11 program via the Block II and III upgrades.
- Initiated Multi-Mode Magnetic Detection System (MMMDS) development of magnetometer sensor technologies and deliver the first AN/ASQ-233 magnetometer sensor.
- Initiated the integration of MMMDS sensor hardware/software into towed vehicles and fixed-wing Unmanned Air Vehicles (UAV).
- Initiated development of SAT algorithms for transition to the distributed ASW sensors of the Integrated Undersea Surveillance System, Naval Sea Systems Command (NAVSEA), PE 0204311N (Maritime Surveillance Program).

FY 2006 Plans:

- Continue all FY 2005 efforts less those noted as completed.
- Complete performance evaluation of a CTDCL prototype torpedo protection system capable of countering two torpedoes launched in rapid succession. All CTDCL efforts transfer to and are reported under PE 0603123N in FY 2007.
- Complete collection and analysis of MMMDS performance data. This work transitioned from PE 0602747N.
- Complete evaluation of proposed MMMDS processing approaches and down-select to one approach. This work transitioned from PE 0602747N.
- Complete planning for MMMDS tests that utilize fixed wing aircraft, helicopter, and UAV platforms.

FY 2007 Plans:

- Continue all FY 2006 efforts less those noted as completed.
- Complete development and demonstration of SAT threat submarine detection and classification algorithms; transition to NAVSEA under PE 0603561N (Advanced Submarine System Development), Project 0223 (Submarine Combat Systems Improvements) and PE 0204311N (Maritime Surveillance Program).
- Complete MMMDS development of magnetometer sensor technologies.
- Complete test flights to collect relevant MMMDS data.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

	FY 2005	FY 2006	FY 2007
COOPERATIVE ANTI-SUBMARINE WARFARE (ASW)	2,366	0	0

Cooperative ASW technology developments enable ASW platforms to work together effectively to detect, classify and localize very quiet undersea targets. The Integrated ASW (IASW) effort has since been terminated due to budget reductions. The focus of this project is to demonstrate the operational utility of employing these IASW tools together with ASW sensor technologies developed as part of the Battlegroup ASW Defense, Wide Area ASW Surveillance, and Neutralization program areas. Demonstrations are conducted primarily in conjunction with Fleet platforms and exercises. This activity includes support to Project Morgan the details of which are classified. Project Morgan funding transfered to PE 0603734N, Project 1804 in FY 2005 through FY 2007.

Beginning in FY 2005 testing and demonstrations associated with LWAD are reported as part of the overall technologies being tested/demonstrated in this PE. As a result, funding no longer is reported under Cooperative ASW, rather it is included in the other activities. This change causes an additional shift among the R-2 Activities.

FY 2005 Accomplishments:

- Continued LWAD activities for two littoral ASW at-sea experiments.
- Testing and demonstrations associated with LWAD activities are reported in the future as an integral part of the overall technologies being tested/demonstrated in other PE 0603747N activities.

	FY 2005	FY 2006	FY 2007
NEUTRALIZATION	14,858	0	3,528

Neutralization focuses on undersea weapons technologies to counter threat submarines by increasing the Probability of Kill (PK). Weapon technology areas include: Torpedo Bridging Technologies (TBT) which addresses development of technologies to enable a heavyweight torpedo (HWT) and a shooting platform to be effectively employed as a fully-linked weapon system utilizing a fiber optic link, broadband signal processing, and behavior based control; and the SwampWorks advanced torpedo effort which demonstrates technologies to meet emerging challenges of low Doppler, small targets (diesel submarines), in harsh littoral

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

environments. The ultimate goals of Neutralization efforts are to develop reduced size advanced undersea weapons with revolutionary capabilities and to fill Sea Shield mission capability gaps and demonstrate transformational capabilities for anti-submarine warfare weapons.

As described under the Cooperative ASW Activity, beginning in FY 2005 testing and demonstrations associated with LWAD will be reported as part of the overall technologies being tested/demonstrated in this PE. As a result, funding no longer is reported under Cooperative ASW, rather it is included in the other activities. This change causes an additional shift among the R-2 Activities.

FY 2006 reflects the transfer of funds requirements associated with Swampworks to PE 0603758N. FY 2007 reflects continuation of TBT development efforts funded in FY 2005.

FY 2005 Accomplishments:

- Continued demonstration of the SwampWorks advanced half-length torpedo vehicle including self noise, stability and control, and a proof-of-concept littoral upgrade to the MK48 Advanced Capability sonar
- Continued transition of broadband signal processing algorithms to Naval Sea Systems Command (NAVSEA) Advanced Systems Technology Office Advanced Processing Build (APB) – Acoustic in PE 0603561N.
- Continued planning and logistics for in-water demonstration of an improved PK for close-in, submarine-on-submarine engagements. (SwampWorks)
- Continued the development and transition (PE 0603561N) of a sonar for the new lightweight torpedo, MK54, under the auspices of SwampWorks.
- Completed development and demonstration of technologies to enable a torpedo and a shooting platform to be effectively employed as a fully linked weapon system incorporating TBT.
- Initiated and completed transition of TBT weapon control tactics to conduct advanced counter-countermeasure algorithms and Initiated and completed area of uncertainty multi-way-point search to NAVSEA MK48 Common Broadband Sonar System (CBASS) program. (PE 0603561N)
- Initiated and completed transition of dual band frequency agile signal processing software, documentation, and data developed under TBT to the NAVSEA(PMS404) MK48 CBASS program. (PE 0603561N)
- Initiated and completed development, integration, and closed loop in-water demonstration of a fully coherent broadband signal processing sonar system with advanced tactics in a behavior based Torpedo Intelligent Controller (TIC) for transition to the MK48 CBASS torpedo (TBT).
- Initiated and completed transition of a narrow band adaptive beamforming simulation module and weapon source code algorithm developed under TBT to the new common baseline MK54/MK48 CBASS software APB process (PMS404)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

which will operate with MK48 ADCAP or MK54 lightweight torpedo (LWT) waveforms. (PE 0603561N)
- Initiated and completed transition of fully coherent broadband Low Doppler signal processing software, documentation and data developed under TBT to the MK48 CBASS program (PMS404). (PE 0603561N)
- Initiated and completed transition of the TBT developed TIC architecture, source code, documentation and development tools with completed area of uncertainty based search, classification, homing, countermeasure and terminal homing behaviors to the MK48 CBASS program (PMS404) via the Torpedo APB process. (PE 0603561N)
- Initiated and completed transition of the integration and validation of a high fidelity bottom model (developed under 0602747N) capable of simulating statistical and fixed position ocean bottom false alarms and false targets at undersea weapons frequencies and initiated reuse development and integration of this model across the undersea weapon simulation community.
- Initiated and completed TBT high fidelity simulation based evaluation of weapon signal processing and HWT tactical control technologies.

FY 2006 Plans:

- All SwampWorks related activities will transfer to PE 0603758N in FY 2006 and out.

FY 2007 Plans:

- Initiate LWT Technology (LWTT) integration of broadband and adjunct sensors for in-water data collection to result in a new dual-mode sensor guidance and control system.
- Initiate LWTT scale up and testing of a directed blast warhead prototype using approved insensitive explosives to quantify attainable ASW and antisurface warfare lethality in the Mk 54 form factor.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0204311N (Integrated Surveillance System)
PE 0205620N (Surface ASW Combat System Integration)
PE 0601153N (Defense Research Sciences)
PE 0602235N (Common Picture Applied Research)
PE 0602435N (Ocean Warfighting Environment Applied Research)
PE 0602747N (Undersea Warfare Applied Research)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0603235N (Common Picture Advanced Technology)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

PE 0603254N (ASW Systems Development)
PE 0603506N (Surface Ship Torpedo Defense)
PE 0603513N (Shipboard System Component Development)
PE 0603553N (Surface ASW)
PE 0603734N (CHALK CORAL)
PE 0604221N (P-3 Modernization Program)
PE 0604261N (Acoustic Search Sensors)
PE 0604503N (SSN-688 and Trident Modernization)
PE 0604784N (Distributed Surveillance System)

NON-NAVY RELATED RDT&E:
PE 0603175C (Ballistic Missile Defense Technology)
PE 0602702E (Tactical Technology)
PE 0603739E (Advanced Electronics Technologies)
PE 0603763E (Marine Technology)

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
HAWAII UNDERSEA VEHICLE TEST AND TRAINING ENVIRONMENT	2,507	1,700

FY 2005 - Developed and tested advanced technologies to meet operational requirements related to the Advanced Swimmer Delivery Vehicle.

FY 2006 - This effort supports the Hawaii undersea vehicle test and training environment.

	FY 2005	FY 2006
LITTORAL AWS MISSION FOR RIGID HULL-INFLATABLE BOAT (RHIB)	964	0

Initiated adaptation and testing of a Variable Depth Sonar System Anti-Submarine Warfare mission package for the Rigid Hull-Inflatable Boat.

	FY 2005	FY 2006
MPP/APB TORPEDO IMPROVEMENT PROGRAM	0	4,000

This effort supports the MPP/APB torpedo improvement program.

	FY 2005	FY 2006
SAUVIM	1,254	1,000

FY 2005 - Continued development and demonstration of an unmanned, underwater vehicle capable of navigation, station keeping and performing complex tasks using a robotic arm, all with minimal interaction from an operator stationed on the ocean surface. Strong underwater currents and limited visibility exacerbate the problem of vehicle navigation and control. Performing tasks with the arm requires the development of complex robotic control algorithms and the capability to recognize and determine the dimensions of underwater objects.

FY 2006 - This effort supports SAUVIM research.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

	FY 2005	FY 2006
SEA TEST FOR TOWED ACOUSTIC ARRAYS	1,928	0

Expanded the previous at-sea test to extend the existing array shape prediction capability to include the TB-16 towed array under drastic maneuvering and high speed conditions.

	FY 2005	FY 2006
VALIDATION AND IMPLEMENTATION OF SENSOR SWEET SPOT SELECTION ALGORITHMS	0	1,250

This effort supports validation and implementation of sensor sweet spot selection algorithms research.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603757N
PROGRAM ELEMENT TITLE: JOINT WARFARE EXPERIMENTS

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	1	0	0	0	0	0	0
3010 JFCOM- JOINT SIMULATION SYSTEM	1	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Secretary of Defense tasked U.S. Joint Forces Command (USJFCOM) with the responsibility for maintaining Joint Simulations System (JSIMS) software and establishing a Software Support Facility (SSF) at the Joint Warfighting Center, pending the results of an Analysis of Alternatives (AoA). The mission of this program is to create a SSF to support the delivery and maintenance of Block I of the JSIMS. JSIMS Block I delivers to the Joint Warfighting Center the simulation capability to train Joint Force Commanders, their components, and staffs. JSIMS is the next generation modeling and simulation tool that will be the cornerstone for Training Transformation and will be one of the key tools to the success of the Joint National Training Center (JNTC).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603757N
PROGRAM ELEMENT TITLE: JOINT WARFARE EXPERIMENTS

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	26	0	0
Execution Adjustments	-24	0	0
FY 2005 SBIR	-1	0	0
FY 2007 President's Budget Submission	1	0	0

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Requirements and funding were realigned to BA 4 in FY 2005 and out.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603757N PROGRAM ELEMENT TITLE: JOINT WARFARE EXPERIMENTS
PROJECT NUMBER: 3010 PROJECT TITLE: JFCOM- JOINT SIMULATION SYSTEM

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
3010 JFCOM- JOINT SIMULATION SYSTEM	1	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Secretary of Defense tasked U.S. Joint Forces Command (USJFCOM) with the responsibility for maintaining Joint Simulations System (JSIMS) software and establishing a Software Support Facility (SSF) at the Joint Warfighting Center, pending the results of an Analysis of Alternatives (AoA). The mission of this program is to create a SSF to support the delivery and maintenance of Block I of the JSIMS. JSIMS Block I delivers to the Joint Warfighting Center the simulation capability to train Joint Force Commanders, their components, and staffs. JSIMS is the next generation modeling and simulation tool that will be the cornerstone for Training Transformation and will be one of the key tools to the success of the Joint National Training Center (JNTC).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
JOINT SIMULATION SYSTEM	1	0	0

JSIMS funding and requirements were realigned to BA 4 for FY 2005 and out. The remaining balance will be reprogrammed to PE 0603727N during execution.

FY 2005 Accomplishments:

JSIMS funding and requirements were realigned to BA 4 for FY 2005 and out.

FY 2006 Plans:

Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603757N PROGRAM ELEMENT TITLE: JOINT WARFARE EXPERIMENTS
PROJECT NUMBER: 3010 PROJECT TITLE: JFCOM- JOINT SIMULATION SYSTEM

FY 2007 Plans:

Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
0603727N Navy Technical Presentation Information System.

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	25,847	48,549	41,308	37,416	66,460	73,407	73,997
2918 NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS	25,847	48,549	41,308	37,416	66,460	73,407	73,997

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The mission of this program is to develop technologies from a subscale proof-of-principle into a full-scale prototype and provide it to the warfighter to experiment with during Fleet Battle Experiments (FBE), Limited Objective Experiments (LOEs) and Sea Trial Exercises.

The purpose of Sea Trials, and other warfighter demonstrations such as FBEs and LOEs, is for the warfighter to explore and experiment with new technologies, modify existing technologies and or develop new Concepts of Operation (CONOPS) in the most realistic scenario possible. Frequently, new CONOPS are enabled by new technology applications. The investment described herein seeks to develop, demonstrate and deliver to the warfighter for experimentation new technologies used during Sea Trial exercises, FBEs or LOEs. These technologies are fielded as robust prototypes to allow the warfighter to completely assess a new capability. These fieldable prototypes are referred to as Operational Experimentation Articles (OEAs). Inasmuch as these OEAs are for warfighter experimentation, it is unlikely that documented requirements exist in the Acquisition Program of Record (POR). Nonetheless, after the technology capability has been successfully demonstrated, and the new CONOP has been integrated into military doctrine, then the technology can be inserted into the appropriate POR. An example of this is networked Specific Emitter Identification (SEI), for which no requirement existed in the surface platform community when the project started in FY02. After demonstration and experimentation during FBE-K, Sea Trials in Jun 04 and Combined Joint Task Force (CJTFEX) 04-02, the technology transitioned into the Surface Electronic Warfare Improvement Program (SEWIP). Similarly, the Forcenet project is intended to yield the tangible evidence needed for the Forcenet Resource/Requirements Sponsor (N61) to define requirements for the Knowledge Management part of Forcenet.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

In order to identify the technology areas with the highest relevance, ONR works in collaboration with the Commander, Fleet Forces Command (CFFC), Navy Warfare Development Command (NWDC), the numbered fleets and the Resource/Requirements sponsor in Naval Operations because these commands are responsible for generating, experimenting with, and implementing new CONOPS.

Current efforts support future operational concepts such as Forcenet and Organic Mine Countermeasures, and operational gaps that have been identified during Operation Iraqi Freedom (OIF) and other recent operations. For Organic Mine Countermeasures the investment is concentrated on autonomous undersea vehicles; and, for Forcenet, the investment is concentrated on the development of Knowledge Management tools. For OIF, the technologies being prototyped and experimented with are sniper detection, wireless/portable/scalable/reconfigurable surveillance systems, and optical/infrared sensors to detect rockets.

This project supports the DON Transformation Roadmap and, in particular, the “Sea Trial Process for Innovation” aspects.

In FY06 this program element (PE) invests in two separate programs, SwampWorks and Tech Solutions. The objectives of these projects share many common elements with the Navy Experimentation Program already described. SwampWorks seeks to develop and demonstrate technologies that address emergent and enduring operational problems in an accelerated timeframe. Some of these technologies may end up in the hands of the warfighter for experimentation or may culminate in a significant exercise that demonstrates capability then transitions into the Acquisition POR. Example successes are the half-length torpedo which led to the development of the SwampWorks Broadband Sonar that transitioning to the Mk 48 ADCAP Program. Efforts includes the development and demonstration of celestial navigation systems, jet noise mitigation technologies, blast resistant structures, undersea acoustic communications and a high resolution sonar for the new lightweight torpedo, Mk 54. Tech Solutions seeks to resolve operational problems submitted by the deckplate sailor via the website, apply scientific applications to solve these operational problems, and provide the solution to the sailor for evaluation and use. Tech Solutions projects includes a deck scrubber for the Aircraft Carriers, helmet-mounted communications for the Marines, extremity protection (body armor for limbs) for the Marines, and dust abatement to retain visibility during helicopter landings in the desert. For SwampWorks and Tech Solutions, some of these projects are ongoing and were previously described in the PEs dedicated to the appropriate mission area. Based on a review of the DON S&T program conducted in FY04, a recommendation was made to collect these efforts into one integrated program that is budgeted and funded from one program element. Due to the common goals of “getting applications into the hands of the warfighter” and developing

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

technologies across the operational spectrum, SwampWorks and Tech Solutions will be reflected in this PE starting in FY06.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	15,743	49,288	49,366
Congressional Undistributed Reductions/Rescissions	-12	-739	0
Execution Adjustments	7,745	0	0
FY 2005 SBIR	-257	0	0
GWOT Counter IED Efforts	2,625	0	0
Program Adjustments	3	0	-8,599
Program Realignment	0	0	611
Rate Adjustments	0	0	-70
FY 2007 President's Budget Submission	25,847	48,549	41,308

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Increase from FY05 to FY06 is due to realigning SwampWorks and Tech Solutions previously funded under other S&T PEs.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The performance of the work funded in this PE is reviewed at several levels to ensure that the investment is relevant and productive:

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

At the macroscopic level, the investment is coordinated with NWDC and CFFC to address the goals and objectives identified for Sea Trials and LOEs. Review at this level occurs at least 4 times a year at the Science and Technology Executive Steering Committee (STESC).

At the microscopic level, the work funded in this PE is reviewed periodically by the ONR program manager to ensure the investment is meeting the goals defined for each project. This review includes feedback collected from the warfighter community on all Sea Trials and LOE to support the program manager's assessment of the value and relevance of each investment. Furthermore, the entire program is reviewed yearly by the Chief of Naval Research.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: 2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2918 NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS	25,847	48,549	41,308	37,416	66,460	73,407	73,997

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The mission of this project is to develop technologies from a subscale proof-of-principle into a full-scale prototype and provide it to the warfighter to experiment with during FBE, LOEs and Sea Trial Exercises. In order to maximize the yield of fieldable prototypes that are available for experimentation, a two-pronged approach is used: 1) Concept-based: invest in technologies to fulfill future CONOPS being explored by CFFC, NWDC and the numbered fleets and, 2) Technology-based: capitalize on technology breakthroughs to demonstrate and provide OEAs (prototypes) that were not previously envisioned by the warfighter but are responsive to an operational need.

In order to identify the technology areas with the highest relevance, Office of Naval Research (ONR) works in collaboration with the CFFC, NWDC, the numbered fleets and the CNO Resource/Requirements sponsor responsible for generating, experimenting with and implementing new CONOPS. The highest priority CONOPS include Organic Mine Countermeasures and Forcenet, therefore the Concept-based fraction of the portfolio is invested in technologies to support these CONOPS. In the Technology-based fraction of the portfolio, ONR has invested in operational gaps identified during OIF and other recent operations as well as technologies that enable network-centric warfare and related technologies.

This project supports the DON Transformation Roadmap and, in particular, the “Sea Trial Process for Innovation” aspects.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: 2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
NAVAL WARFARE EXPERIMENTATION ARTICLES - TECHNOLOGY-BASED	8,457	12,136	11,057

The objective of this project is to capitalize on recent technology breakthroughs to develop prototypes quickly and provide them to the warfighter for experimentation during Sea Trials or LOEs.

FY 2005 Accomplishments:

- Completed experimentation with the integrated sensor suite installed on the HSV-X2.
- Completed testing of electromagnetic sensors for anti-submarine warfare cueing. The sensors accurately detected and classified several platforms.
- Completed the improvements to the gun detection and location (GDL) units so that they are more robust in the operational environment. These units (5 High Mobility Multi-Wheeled Vehicles (HMMVWs) integrated with GDL technology) were delivered to Marine Corps Warfighting Laboratory (MCWL) for testing and evaluation. (Testing has been completed but analyzed results are not yet available).
- Completed personnel counter IED jamming and predetonation development and technology.

FY 2006 Plans:

- Initiate the development of an unmanned aerial vehicle (UAV) with jamming capability for Suppression of Enemy Air Defenses (SEAD) and IED initiatives.
- Complete the fabrication of several units of the electromagnetic sensor to support Limited Objective Test with Fleet ASW Command.
- Complete the development of an optical sensor for rocket detection, integrate with the Critical Area Protection System (CAPS) (previously developed in this program and presently deployed in Camp Fallujah) and provide to Marine Corps for experimentation.
- Support the Marine Corps in LOEs with the gun detection and location units and collect data on the performance of the units in an operational scenario.
- Identify other promising technology breakthroughs that can be prototyped and delivered to the warfighter for experimentation.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: 2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

FY 2007 Plans:

- Continue all efforts of FY06 less those noted as completed above.
- Complete the development, fabrication and assembly of standoff jamming for demonstation and technical assessment.
- Complete experimention with Fleet ASW Command to assess the effectiveness of the electromagnetic sensors in cueing in a real-time operational scenario.
- Initiate development and demonstration of real time situational awareness technologies.

	FY 2005	FY 2006	FY 2007
MICROSAT	7,880	0	0

CLASSIFIED PROGRAM

	FY 2005	FY 2006	FY 2007
NAVAL WARFARE EXPERIMENTATION ARTICLES - CONCEPT-BASED FORCENET	4,426	4,429	3,772

This project seeks to develop Knowledge Management (KM) tools for the numbered fleets to use during experimentation exercises. The KM tools developed here are based on intelligent agents, and the application identified by the warfighter which was used to streamline the process of obtaining actionable knowledge. Agents operating in a distributed environment can help by autonomously filtering, retrieving, and processing information, and by matching situational context with established knowledge sources, freeing warfighters from laborious, time intensive, and menial information look up, retrieval, and formatting tasks.

FY 2005 Accomplishments:

- Developed the Battle Watch Captain (BWC) and Common Tactical Picture (CTP) Manager for C2F. These were two KM tools (so-called intelligent agents) developed to support the intelligence officers in the collection, integration and analysis of data. Held remote and on-site mini LOEs leading to LOE 23-24 Jun 05 and LOE 1-5 Aug 05.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: 2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

• Developed and activated for warfighter experimentation a Joint Worldwide Intelligence Communications System (JWICS) site for C5F and OPINTEL at C3F. Conducted LOE at C3F to present the new capability and to gather more requirements to further enhance its useability.

FY 2006 Plans:

• Continue to develop KM tools for Intel officers in C2F, C3F, C5F, C7F that are robust and the warfighter can use during Sea Trial exercises or LOEs.
• Develop KM tools for the operations officers (J3) in C2F and C5F. Plan and conduct LOEs to assess the effectiveness of these tools in reducing the time and complexity of data collection and analysis.

FY 2007 Plans:

• Continue all efforts of FY06 less those noted as completed above.
• Complete investigation of operational areas that can be served with KM technologies.

	FY 2005	FY 2006	FY 2007
SWAMPWORKS	2,625	19,682	19,003

The increase from FY 2005 to FY 2006 is due to SwampWorks being funded under other S&T PEs. FY 2005 represents Counter IED reprogramming for wearable jamming and detonation technology.

SwampWorks seeks to develop and demonstrate technologies that address emergent and enduring operational problems in an accelerated timeframe. Some of these technologies may end up in the hands of the warfighter for experimentation, or may culminate in a significant exercise that demonstrates capability then transitions into the Acquisition POR. Examples of past successes are the half-length torpedo which led to the development of the SwampWorks Broadband Sonar and is transitioning to the Mk 48 ADCAP program. Current efforts are the development and demonstration of jet noise mitigation technologies, blast resistant structures, undersea acoustic communications and a high resolution sonar for the new lightweight torpedo, Mk 54.

FY 2005 Accomplishments:

• Completed the fabrication of a prototype celestial navigation device for testing.
• Completed the integration of autonomous navigation software into an unmanned aerial vehicle.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: 2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

- Completed the final exercise of the SwampWorks Advanced Torpedo Sonar for the heavyweight torpedo, Mk 48 ADCAP in Nanoose.
- Completed personnel counter IED jamming and detonation development and technology.
- Completed stainless steel monohull design for survivability.
- Identified enduring and emergent operational barriers identified by Naval leadership and responded with relevant technology developments and demonstrations.

FY 2006 Plans:

- Characterize the performance of the celestial navigation device in relevant scenarios that simulate operational conditions.
- Complete the development of the advanced sonar for the Mk54 torpedo and characterize its performance in a submarine exercise.
- Initiate the development of new technologies that are responsive to Taskforce Antisubmarine Warfare (TF ASW), recently developed Concept of Operation.
- Complete the installation of the Aircraft Carrier Situational Awareness System (ACSAS) (provides 360-degree sensing, detection and tracking for Aircraft Carriers when transiting in ports and restricted waterways when high-powered radars must be turned off) on the USS Theodore Roosevelt.
- Continue to identify enduring and emergent operational barriers identified by naval leadership and respond with relevant technology developments and demonstrations.
- Initiate personnel self protection technologies.
- Initiate an investigation and development of technologies that reduce energy consumption losses during recent operations.

FY 2007 Plans:

- Continue all efforts of FY06 less those noted as completed above.
- Initiate studies of climate effects on operations and identify potential mitigating technologies.
- Initiate development of vehicle technologies to address survivability, fuel economies and blast mitigation.
- Initiate novel heavy fuel propulsion system development.
- Initiate development of new methods applying breakthrough cognitive technologies, in behavioral, computational, and mathematical sciences to relevant Naval systems.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: 2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

	FY 2005	FY 2006	FY 2007
NAVAL WARFARE EXPERIMENTATION ARTICLES - CONCEPT-BASED ORGANIC MINE COUNTERMEASURES	2,459	2,461	0

The objective of this project is to develop and experiment with unmanned underwater vehicles (UUVs) modularized for mine warfare (MIW) and mine countermeasures (MCM) during fleet exercises and experiments. Targeted ships of opportunity include the High Speed Vessel (HSV-2) SWIFT, the X-Craft and other surface platforms engaged in MCM operations. With the development of the Littoral Combat Ship (LCS), the Navy has included the development of warfare mission module packages to support Fleet operations in MIW, anti-submarine warfare and anti-surface warfare. The HSV provides a means of effecting spiral development of both the LCS platform and the support mission modules. UUV technology developed within the Organic Mine Countermeasures Future Naval Capability (OMCM FNC) program has been designated for inclusion in LCS Flight 0 ships. Included within the objectives of this program is the development of additional capabilities for existing UUV technology, the development of prototypical UUV mission modules for MCM, and the integration of the modularized UUV system into experimentation platforms of opportunity.

FY 2005 Accomplishments:

- Completed delivery, acceptance testing and certification of the second set of REMUS 100 UUVs.
- Initiated FY 2005 experimentation, with HSV event 3-14 December 2004 (GOMEX 05-1 in Panama City OPAREA).
- Awarded new hybrid UUV module contract, with delivery in the 4th Quarter of FY 2005.

FY 2006 Plans:

- Provide UUV mission modules for the Sea Trial event in the Panama Canal Exercise, a mine warfare training and readiness exercise (which includes the HSV SWIFT).
- The UUV mission module program will continue with experimentation on craft of opportunity, in particular the HSV-2 SWIFT and X-Craft, and will support the Littoral Combat Ship mine warfare mission module development program.

FY 2007 Plans:

- Program ends in FY 2006.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: 2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

	FY 2005	FY 2006	FY 2007
TECH SOLUTIONS	0	9,841	7,476

*Tech Solutions was previously funded under other S&T PEs.

The objective of this program is to provide deckplate sailors with technical solutions to common operational problems. The sailors provide their operational issues to ONR via the web.

FY 2005 Accomplishments:

- Developed, demonstrated and delivered to the Marines dust abatement technology that can be used to retain visibility during landings in the desert. The product delivered reduces the complexity of the application process (from 12-steps to 1-step).
- Developed, demonstrated and delivered to the Marines extremity protection.
- Developed, demonstrated and delivered to the Navy an enhancement to their binoculars (Big Eyes) that increased the range of visibility and provided line-of-sight communications.

FY 2006 Plans:

- Initiate development of a portal for explosive detection that utilizes infrared detection.
- Initiate development of a marker for search and rescue that does not interfere with radio frequency communications called a Search and Rescue Low Probability of Interference Marker.
- Obtain feedback from extremity protection and dust palliatives that have been deployed and make enhancements as appropriate.
- Continue to obtain operational problems from the sailors via the web and develop, demonstrate and deliver technical solutions.

FY 2007 Plans:

- Continue all efforts in FY06 less those noted as completed above.
- Complete development of ballistic goggles that provide eye protection for ground troops and are adaptive to changing light conditions.
- Complete development and testing of ballistic net protection system.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: 2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

FY 2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2006
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	36,364	35,112	21,326	49,293	67,309	74,699	74,727
2917 MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY	33,760	31,412	21,326	49,293	67,309	74,699	74,727
9999 CONGRESSIONAL PLUS-UPS	2,604	3,700	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element primarily develops and demonstrates prototype Mine Countermeasures (MCM) and Expeditionary Warfare system components that support capabilities enabling Naval Forces to influence operations ashore. Third-world nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics, throughout the littoral battlespace. Real world operations have demonstrated the requirement to quickly counter the mine threat. Advanced technologies must rapidly detect and neutralize all mine types, from deep water to the inland objective. This program supports the advanced development and integration of sensors, processing, warheads and delivery vehicles to demonstrate improved Naval Warfare capabilities. It supports the MCM-related and Urban Asymmetric/Expeditionary Warfare Operations (UAEO)-related Future Naval Capabilities (FNC) Enabling Capabilities (ECs). Within the Naval Transformation Roadmap, this investment will achieve one of three key transformational capabilities required by Sea Shield as well as technically enable the Ship to Objective Maneuver (STOM) key transformational capability within Sea Strike.

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

B. PROGRAM CHANGE SUMMARY:

	FY 2005	FY 2006	FY 2007
FY 2006 President's Budget Submission	35,255	31,897	34,554
Congressional Action	0	3,700	0
Congressional Undistributed Reductions/Rescissions	-27	-485	0
Execution Adjustments	230	0	0
FY 2005 SBIR	-431	0	0
GWOT Counter IED Efforts	1,330	0	0
Program Adjustments	7	0	0
Program Realignment	0	0	-13,191
Rate Adjustments	0	0	-37
FY 2007 President's Budget Submission	36,364	35,112	21,326

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

E. PERFORMANCE METRICS:
The overall metrics of this applied research program are the development of technologies which focus on the Expeditionary Warfare challenge of speeding the tactical timeline and removing personnel from minefields. Another important metric is the transition of 6.3 advanced technology projects into acquisition programs. Example metrics include: a. MCM sensor data fusion = 10%-25% reduction in time and risk; b. buried mine sensor

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

- probability of detection = .95, probability of classification = .8; packaged in 12 inch x 72 inch vehicle during a 12 hour mission with a search rate greater than .05 square nautical mines per hour; c. mine sweeping - magnetic/acoustic influence sweeping; single sortie coverage greater than 9.4 square nautical mines at 20 nautical miles per hour, 4 hour mission; and d. advanced sonars and processing - automated target recognition accuracy speed greater than 5 times faster than trained sonar analyst against a B-2 bottom.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2917 PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2005 Actual	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
2917 MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY	33,760	31,412	21,326	49,293	67,309	74,699	74,727

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project primarily develops and demonstrates prototype Mine Countermeasures (MCM) and Urban Asymmetric/Expeditionary Warfare Operations (UAEO) technologies that support a range of capabilities enabling Naval Forces to influence operations ashore. Third-world nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics. Recent operations have demonstrated the requirement to counter the projected mine threat. Advanced technologies are required to rapidly detect and neutralize all mine types, from deep water to the inland objective. This project supports the advanced development and integration of sensors, processing, warheads and delivery vehicles. It supports the MCM-related and UAEO-related Future Naval Capabilities (FNC) Enabling Capabilities (ECs).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2005	FY 2006	FY 2007
MINE/OBSTACLE DETECTION	16,325	15,163	13,120

This activity focuses on developing and demonstrating technologies that support detection, classification, identification and multi-sensor data fusion of mine and obstacle data to speed tactical timelines and increase operator standoff. Efforts include: electro-optic (E-O) sensors/systems to enable unmanned airborne vehicle (UAV) rapid minefield reconnaissance and precise mineline location from very shallow water (VSW) through the beach zone (BZ); sensors/systems to enable cooperating unmanned underwater vehicles (UUVs) to perform wide-area reconnaissance and assault lane reconnaissance/preparation from shallow water (SW) through the surf zone (SZ); sensor development for detection and classification of buried mines; technologies for MCM Mission Modules for the new Littoral Combat Ships (LCS); and sensor data fusion to enable a theater mine warfare common operating picture and own ship protection. This activity supports the development and transition of technologies for the Mine Countermeasure (MCM)-related FNC Enabling Capabilities.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2917 PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

The funding profile from FY06 to FY07 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Mine Countermeasures Capacity Spiral 1 and 2; and Mine Countermeasures for Maneuver Spiral 1 and 2.

FY 2005 Accomplishments:

-Continued demonstration of capability to enable diver teams with UUVs to efficiently and accurately reacquire previously targeted areas and individual targets.
-Continued demonstration of integrated UUV search, marking, mapping of bathymetry, threat objects and gaps and report back in test-bed minefields in VSW environments.
-Continued integration of Laser Scaler Gradiometer (LSG) in UUV.
-Continued development of multi-platform fusion of high-resolution mine hunting systems (e.g. AN/AQS-20) for improved mine detection and avoidance.
-Completed component integration and demonstrated, at-sea, the small object avoidance processing string in the SQS-53C sonar Integrated Peer Review (IPS) adjunct processing system and prepared for transition.
-Completed integration of dual frequency small Synthetic Aperture Sonar (SAS) into UUV for reconnaissance and initiate field evaluation.
-Completed development of Rapid Overt Airborne Reconnaissance (ROAR) multispectral laser, 3-D camera for tactical airborne VSW/SZ/BZ day/night mine/minefield/obstacle detection.
-Initiated at-sea testing of ROAR sensor and began helicopter integration.

FY 2006 Plans:

-Continue all FY 2005 efforts less those noted as completed above.
-Complete at-sea testing of ROAR sensor for tactical airborne VSW/SZ/BZ day/night mine/minefield/obstacle detection and initiate transition to PMS-495.
-Complete integration of LSG into UUV and initiate field evaluation of LSG performance against buried mines.
-Complete transition of the small object avoidance processing string in the SQS-53C Integrated Peer Review (IPS) adjunct processing system.
-Initiate system development for Over-the-Horizon (OTH) deployment of UUV systems by Autonomous Surface Vehicles (ASVs) and large UUVs.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2917 PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

-Initiate development of buried minefield detection capability for Tactical Unmanned Aerial Vehicle (TUAV)-based SZ/BZ buried minefield detection.
-Initiate preliminary planning and testing of buried minehunting systems on UUV platforms.

FY 2007 Plans:

-Continue all FY 2006 efforts less those noted as completed above.
-Demonstrate buried minehunting with a combined LSG and dual frequency SAS sensor suite in a UUV in a Fleet exercise.
-Initiate multiple unmanned system MCM data fusion techniques for reduction in false alarms and reduction in tactical timelines.
-Initiate technology development, integration and early demonstration planning for MCM Mission Module systems for Advanced Flight LCS.
-Initiate advanced processing development for Low Frequency Broad Band (LFBB) to enable rapid detection, classification and identification of buried sea mines.

	FY 2005	FY 2006	FY 2007
MINE/OBSTACLE NEUTRALIZATION	12,945	9,749	8,206

Mine and Obstacle Neutralization activity is focused on dramatically improving the capability to neutralize mines and obstacles from deep water through the beach exit zone. Efforts include the development of technologies for: stand-off breaching of mines and obstacles in the surf and beach zones (SZ/BZ); minesweeping and jamming of sea mines; and expendable, autonomous underwater vehicle (AUV) neutralization of sea mines. Stand-off breaching efforts will demonstrate a mine and obstacle breaching capability that is enabled by precision weapon guidance and Intelligence, Surveillance, and Reconnaissance (ISR), and delivered by Naval Tactical Aircraft (TACAIR), USAF Bombers, and Naval guns. In the near-term, tactical performance of existing unitary bombs will be demonstrated. Other efforts will demonstrate a tactical countermine dart and dispenser concept. The minesweeping effort will develop a mission package for deployment on Unmanned Surface Vehicles (USVs). Also, efforts will focus on improving an existing breaching weapon fuze and developing a precision assault lane marking navigation capability. This activity supports the development and transition of technologies for the MCM-related FNC ECs.

The funding profile from FY06 to FY07 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2917 PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Mine Countermeasures Capacity Spiral 2; and Mine Countermeasures for Maneuver Spiral 1 and 2.

FY 2005 Accomplishments:

-Completed development of an Assault Breaching Mission Planner, demonstrate utility with Mine Warfare Environmental Decision Aids Library (MEDAL), and began transition to PMS-495.
-Completed performance characterization of Mk-84 bombs against buried mines.
-Completed development of USV minesweeping payload (spiral 1); completed integration on a USV; conducted technology demonstration of mine influence sweep payload performance; conducted initial fleet demonstration of early USV mine sweeping capability from a High Speed Vehicle (HSV).
-Conducted demonstration of dart dispensing technologies and integration of payload and delivery platforms for system level demonstrations and conduct 2nd flight test of the Mine and Obstacle Defeat System (MODS) with a full payload of inert darts.
-Initiated dart fabrication and began planning FY06 MODS “live” payload demonstration.
-Initiated development of USV minesweeping module concept for the Littoral Combat Ship (LCS).
-Initiated development of mechanical designs for neutralization of moored and bottom mines in VSW.

FY 2006 Plans:

-Complete dart fabrication and complete MODS flight demonstration of the dispensing of live darts against live tactical mines.
-Complete mechanical designs for neutralization of bottom and moored mines in Very Shallow Water (VSW) then implement and test.
-Conduct technology demo of mine influence sweep payload performance; conduct initial fleet demo of early USV sweeping capability from an HSV.
-Initiate and complete integration of Mk-84 bomb lethality data for proud and buried mines and obstacles into MEDAL.
-Initiate the transition of countermine dart warhead technology to PMS-495.
-Initiate countermine dart lethality optimization in coordination with PMS-495.
-Initiate countermine dart dispensing optimization in coordination with PMS-495
-Initiate development of low drag, low frequency sound source for mine influence sweeping.
-Initiate development of advanced mine influence sweeping payload for USVs, focusing on increasing swept path

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2917 PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

and endurance.

FY 2007 Plans:

-Continue all FY 2006 efforts less those noted as completed above.
-Complete development and demonstration of USV minesweeping module concept and begin transition to PMS-495.
-Complete countermine dart lethality optimization.
-Complete transition of countermine dart technology to PMS-495.
-Complete countermine dart dispensing optimization and complete transition of dart dispensing technology to PMS-495.
-Initiate development of an expendable, autonomous underwater vehicle neutralizer, initially focused on neutralization of moored influence sea mines in shallow water.
-Initiate development of advanced influence minesweeping module for unmanned surface vehicle mine sweeping.
-Initiate development of stand-off, assault breaching warhead fuse to extend effectiveness of unitary warheads to greater water depths.
-Initiate technology development of precision navigation capability for targeting, safe navigation through assault lanes including lane marking.

	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT	4,490	6,500	0

Within the Naval Transformation Roadmap, this investment supports achievement of transformational capabilities of Ship To Objective Maneuver (STOM), a key transformational capability within Sea Strike. This activity develops and demonstrates prototype capability to enable Naval Expeditionary Forces to influence operations ashore. The goal of Littoral Combat is the application of technologies to enhance the ability of the Navy/Marine Corps team to execute the naval portion of a joint campaign in the littorals. This activity considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR), fires, maneuver, sustainment, force protection, and training. The funding profile from FY06 to FY07 reflects the reorganization of Future Naval Capabilities (FNC) Program investments into Enabling Capabilities (ECs). As a result of this reorganization, the funding for each EC has been aligned to a Budget Activity 2 and Budget Activity 3 PE as appropriate. This Activity reflects the alignment of investments for the following ECs: Hostile Fire Detection and Response Spirals 1 and 2, Improvised Explosive Devices Spirals 1 and 2, Modular Scalable Weapon, Advanced Naval Fires Technology Spiral 1, Position-Location-Information, Dynamic Target Engagement & Enhanced Sensor Capabilities, GIG-

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2917 PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

Compliant Networking, and Marine and Unmanned Vehicle Tactical Intelligence, Surveillance and Reconnaissance (ISR).

Starting in FY 2007, investment for Littoral Combat is realigned to PE's 0603640M, 0603235N and 0603114N.

FY 2005 Accomplishments:

-Continued development of fires coordination and fire control system software/hardware for indirect fire weapons systems.
-Continued development of advanced lightweight materials for weapon systems/platforms. (Previous efforts funded by PE 0603640M)
-Continued development of lightweight mission essential computational fire control interfaces for weapons systems. (Previous efforts funded by PE 0603640M)
-Continued development of improved fire control technologies for weapon aiming and pointing systems. (Previous efforts funded by PE 0603640M, 0602236N and PE 0603236N.)
-Continued development of radio frequency (RF) emitter identification and geolocation technology. (Previous efforts funded by PE 0602131M)
-Continued integration and demonstration of secure mobile networks/secure wireless local area network (LAN) communication technologies. (Previous efforts funded by PE 0602782N and PE 0602131M)
-Continued development of planar/phased array electronic attack antenna technology.
-Completed development of an advanced sensor miniature digital data link. (Development also funded by PE 0602782N)

FY 2006 Plans:

-Continue development of fires coordination and control system software/hardware for indirect fire weapons systems. (FY07 work continues in PE 0603114N)
-Continue development of advanced lightweight materials for weapon systems/platforms. (FY07 work continues in PE 0603114N.)
-Continue development of lightweight mission essential computational interfaces for weapons systems. (FY07 effort funded by PE 0603114N)
-Continue development of improved fire control technologies for weapon aiming and pointing systems. (FY07 effort funded by PE 0603114N)
-Continue development of radio frequency (RF) emitter identification and geolocation technology. (FY07 work

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2917 PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

continues in PE 0603640N)
-Continue integration, development and demonstration of secure mobile networks/secure wireless Local Area Network (LAN) communication technologies. (FY07 effort funded by PE 0603640M)
-Continue advanced naval fires technology development Spiral 1. (Previous efforts funded by PE 0602131M and PE 0603640M; FY07 effort funded by PE 0603114N)
-Continue development of advanced ammunition packaging. (Previous and concurrent funding by PE 0602131M and PE 0603640M; FY07 effort funded by PE 0603114N)
-Continue hostile fire detection and response technology development (including Gunslinger). (Previous efforts funded by PE 0602131M) (FY07 work continues in PE 0603114N.)
-Continue development of enhanced sensor fusion Measurement and Signatures Intelligence (MASINT) capabilities. (Previous effort funded by PE 0603640M; FY07 effort funded by PE 0603114N)
-Complete development/testing/demonstration of Signals Intelligence (SIGINT) visualization system technologies in support of Ship to Objective Maneuver (STOM). (Previous efforts funded by PE 0603640M)
-Complete development of planar/phased array electronic attack antenna technology.
-Complete development of advanced sensing algorithms to derive maps using digital imagery and transition to Program of Record. (Previous effort funded by PE 0602131M)
-Initiate development of innovative tactical Global Information Grid (GIG)-compliant networking technologies. (FY 07 effort funded by PE 0603235N)

FY 2007 Plans:

Realigned to PE 0603640M, PE 0603235N and PE 0603114N.

C. OTHER PROGRAM FUNDING SUMMARY:
PE 0601153N (Defense Research Sciences)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602747N (Undersea Warfare Applied Research)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0602435N (Ocean Warfighting Environment Applied Research)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603513N (Shipboard System Component Development)
PE 0603640M (USMC Advanced Technology Demonstration ATD)
PE 0604373N (Airborne MCM)
PE 0604784N (Distributed Surveillance System)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 2917 PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

NON-NAVY RELATED RDT&E:
PE 0602712A (Countermine Systems)
PE 0603606A (Landmine Warfare and Barrier Advanced Technology)

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: 9999 PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

	FY 2005	FY 2006
COUNTERMINE LIDAR UAV-BASED SYSTEM (CLUBS)	964	0

This effort developed Light Detection and Ranging (LIDAR) technology to support the detection of mines and obstacles in the Surf Zone from an Unmanned Aerial Vehicle (UAV).

	FY 2005	FY 2006
MODELING THE WARRIOR AS A COGNITIVE SYSTEM - PHASE II	1,640	1,700

FY 2005: This effort developed situation-specific models for modeling warrior competencies and capabilities across operations, support and training; and also expanded the scope to include emerging missions to better understand the warrior's human factors.
FY 2006: This effort extends beyond the Mobile Field Kit developed during FY 2005 to deliver a web based system that will serve the purpose of improving the educational process for the Advanced Improvised Explosive Device (AIED) School and the warfighter and to provide them both with a portable web based system that collects a variety of AIED training reference material.

	FY 2005	FY 2006
UPWARD LOOKING SENSOR	0	1,000

This effort supports upward looking sensor research.

	FY 2005	FY 2006
VISUAL INTEGRATED BRIDGE SYSTEM	0	1,000

This effort supports visual integrated bridge system research.

EXHIBIT R-2a, RDT&E Project Justification		DATE: FEBRUARY 2006
APPROPRIATION/BUDGET ACTIVITY **RDT&E, N /BA- 3 Advanced Technology Development**	PROGRAM ELEMENT NUMBER AND NAME **0303158M JOINT CMD & CTRL PRG (JC2)**	PROJECT NUMBER AND NAME **C2223 MARINE CORPS ATD**

COST ($ in Millions)	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	
Project Cost	**0.000**	**0.000**	**1.000**	**1.000**	**0.000**	**0.000**	**0.000**	
RDT&E Articles Qty								

(U) A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION:

The Joint Command and Control (JC2) Capability is the DoD's principal command and control capability that will be accessible in a net-centric environment and focused on providing the commander with the data and information needed to make timely, effective and informed decisions. JC2 will be "born" Joint, developed, integrated, tested and used by all Services to improve interoperability, collaborative planning and rapid decision making across all Joint warfighting functions at the Secretary of Defense, Chairman of the Joint Chiefs (CJCS), Combatant Command (COCOM), Joint Task Force (JTF) and Component levels.

JC2 will encompass the inherent capabilities of the Global Command and Control System (GCCS) Family of Systems (FoS) plus additional capabilities not met by GCCS FoS and delineated in the Analysis of Alternatives. As directed, there will be one version of JC2 implemented, integrated and utilized by all Services and Agencies (GCCS-A, GCCS-M, GCCS-AF and GCCS-J capabilities will transition to JC2).

(U) B. ACCOMPLISHMENTS/PLANNED PROGRAM

COST ($ in Millions)		FY 2005	FY 2006	FY 2007
Accomplishment/Effort Subtotal Cost		**0.000**	**0.000**	**1.000**
RDT&E Articles Qty		**0.000**	**0.000**	**0.000**

JC2: Overview and assist with system engineering support, acquisition program support and logistics support.

(U) Total $	0.000	0.000	0.000	1.000

(U) PROJECT CHANGE SUMMARY:	FY 2005	FY 2006	FY 2007
(U) FY (2006) President's Budget:	0.000	0.000	0.000
(U) FY (2007) President's Budget:	0.000	0.000	1.000
Total Adjustment			1.000

Summary of Adjustments

(U) Program start 1.000

Note: Funding for this effort was provided during budget formulation in the correct program element, but was erroneously placed in BA 3 instead of BA 7. It is anticipated that the funds will be transferred to the proper Budget Activity during execution.

EXHIBIT R-2a, RDT&E Project Justification		DATE: FEBRUARY 2006
APPROPRIATION/BUDGET ACTIVITY **RDT&E, N /BA- 3 Advanced Technology Development**	PROGRAM ELEMENT NUMBER AND NAME **0303158M JOINT CMD & CTRL PRG (JC2)**	PROJECT NUMBER AND NAME **C2223 MARINE CORPS ATD**

(U) C. OTHER PROGRAM FUNDING SUMMARY:

Line Item No. & Name	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
(U) Related RDT&E:							
(U) (U) PE# / Title 0303158N							
Joint Command and Control Program (JC2)	0.000	4.925	5.073	5.078	4.938	4.922	4.883

(U) D. ACQUISITION STRATEGY:

An approved acquisition strategy does not currently exist. DISA, with the Services will, develop an acquisition strategy during the Technical Development phase.

(U) E. MAJOR PERFORMERS:

DOD and all services.

Exhibit R-3, Project Cost Analysis						DATE: FEBRUARY 2006								
APPROPRIATION/BUDGET ACTIVITY **RDT&E, N / BA 3 Advanced Technology Development**			PROGRAM ELEMENT **PE 0303158M JC2**					PROJECT NUMBER AND NAME **C2223 MARINE CORPS ATD**						
Cost Categories	Contract Method & Type	Performing Activity & Location	Total PY s Cost	FY 05 Cost	FY PY Award Date	FY 06 Cost	FY 06 Award Date	FY 07 Cost	FY 07 Award Date	FY 08 Cost	FY 08 Award Date	Cost to Comp	Total Cost	Target Value of Contract
JC2	**FFP**	**TBD**		**0.000**		**0.000**		**1.000**	**TBD**	**1.000**	**TBD**	**Cont**	**Cont**	
													0.000	
Subtotal Management			0.000	0.000		0.000		1.000		1.000		Cont	Cont	
Remarks:														
Total Cost			0.000	0.000		0.000		1.000		1.000		Cont	Cont	